INSTRUCTION MANUAL

MODEL FM-10
FREQUENCY METER/SIGNAL GENERATOR

SINGER-GERTSCH MANUAL NO. 1-500783-015(Rev. B)

4/71 SB

THE SINGER COMPANY
GERTSCH OPERATION
3211 South LaCienega Boulevard, Los Angeles, California 90016

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2. Serial Number
3. Description of trouble[2]
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

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(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

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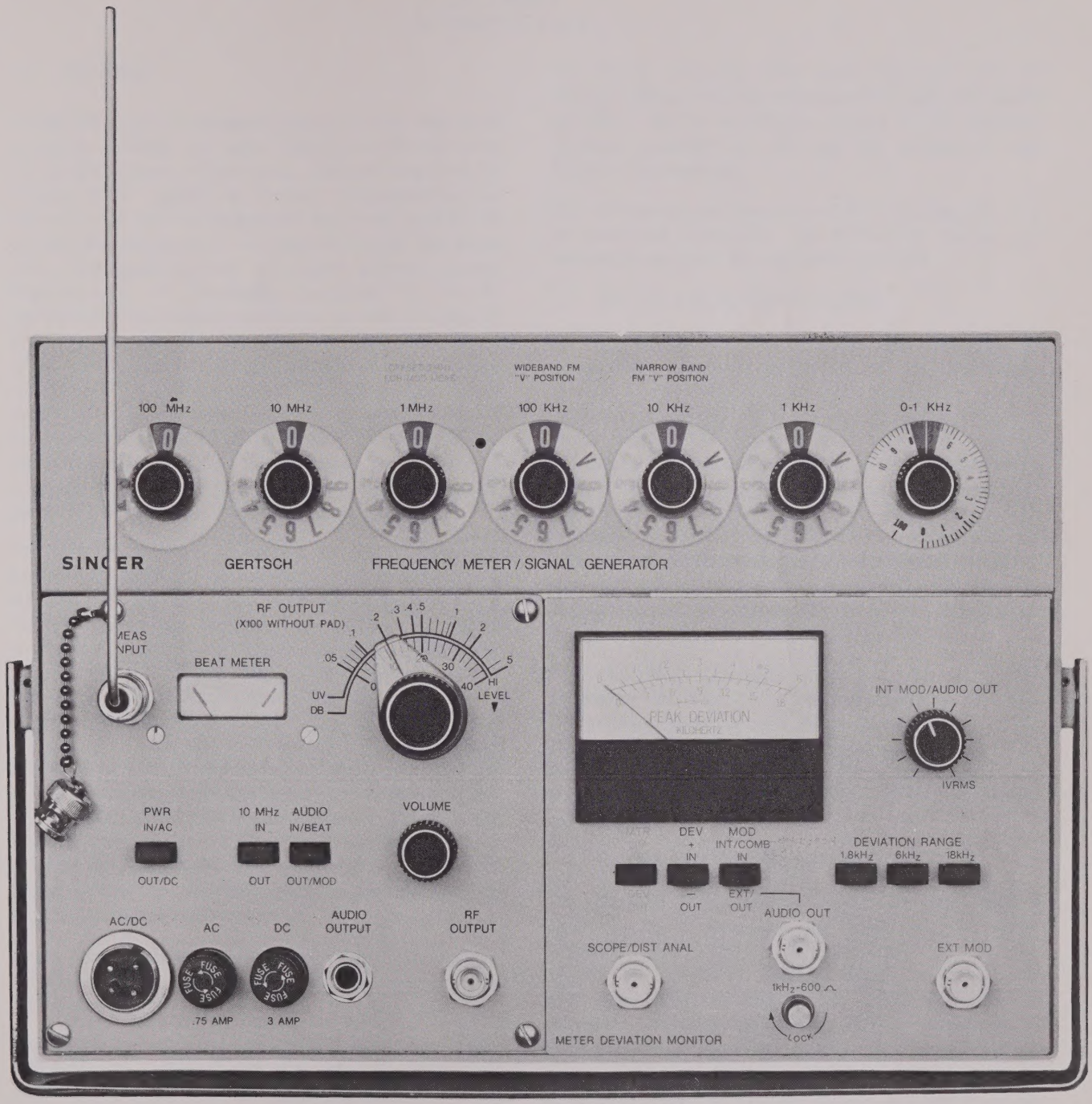


Figure 1-1. Model FM-10, Frequency Meter/Signal Generator
(with MDM-1 plug-in)

SECTION I
INTRODUCTION

1.1 GENERAL

Model FM-10 is a combination frequency meter and signal generator covering the range 100KHz to 500MHz with direct dial readout. It measures an unknown frequency by comparing it against a known, internally-generated frequency. A built-in loudspeaker and front panel meter present the beat note or error signal in audible and visual forms for quick zeroing. A plug-in antenna permits measurements of frequencies broadcast by remote transmitters. Direct signal input is also possible by means of a front-panel connector. Frequencies between 500MHz and 1GHz can be measured by using the second harmonic and multiplying the dial readout by a X2 factor. The FM-10 functions as a frequency generator by switching in an automatic leveling circuit and a calibrated attenuator. These facilities equip the instrument to deliver a precisely-controlled signal over an 80db voltage range at all points of the instrument's frequency spectrum.

The FM-10 employes a method of direct frequency synthesis in which the output frequency is derived from a mixture of the harmonics and sub-harmonics of a highly-accurate base frequency of 10MHz. The direct synthesis technique ensures that the extreme precision and stability of the reference oscillator are transferred to the output signal. Accuracy is one part per million over a wide temperature range at each kilohertz step. The FM-10 is thus suitable as a laboratory frequency standard. Silicon solid-state devices are used throughout the circuitry and the reference frequency is derived from a state-of-the-art TCXO crystal which requires no temperature oven. The FM-10 is thus operational when it is switched on and does not develop significant heat drift. Calibration of the TCXO crystal against an external source is possible without removal of the instrument covers.

The instrument is entirely self-contained and only requires connection to a standard 12V car battery or a 115/230 VAC mains supply.

Ruggedness is sufficient for heavy field use, while portability is achieved through use of lightweight components and inclusion of a carrying handle.

Six decade switches on the front panel permit selection of any frequency in the operating range to within one kilohertz. A seventh control provides continuous coverage from 0 to 1KHz in 20Hz divisions.

No calibrating or locking procedures are required to set up a specific frequency. Any frequency is obtained simply by setting the six step switches and the seventh variable control to the desired value.

The FM-10 performs many other functions used in communications servicing when ancillary plug-in modules are added to the mainframe. Typical of the ancillary functions available are AM and FM modulation and deviation measurement.

The convenience and durability of the FM-10 qualify it as an all-around instrument for production testing and servicing in the hands of semi-skilled operators.

1.2 USE AS A FREQUENCY METER.

1.3 The signal under investigation is supplied to the front panel BNC connector by cable or by the plug-in antenna. The problem of locating the exact position of the unknown frequency in the spectrum is greatly simplified by means of the interpolating oscillator. This provides continuous sweeps over bandwidths of 1MHz, 100KHz or 10KHz, with one turn of the 0-1KHz control. The operator initiates a search with sweeps over 1MHz bands. The procedure is repeated with successive search bands of 100KHz and 10KHz. When the internal frequency is finally balanced against the unknown frequency with all seven decade switches in circuit, the value of the unknown frequency can be read off from the seven dials.

1.4 The FM-10 uses both a meter and a built-in speaker to present the beat note. The meter permits detection of inaudible frequencies near the zero beat (less than 5Hz). There is a volume control and an audio output jack to supply the beat note to a remote speaker when necessary. A 600-ohm speaker is recommended for proper impedance matching.

1.5 USE AS A SIGNAL GENERATOR

1.6 The FM-10 generates an output sine wave which is precise both in frequency and level over the entire frequency range (AM or FM modulation may also be applied by means of optional plug-in modules). An attenuation range of 80db (0.05 – 500 microvolts) is provided with direct readout in db's or microvolts. It also provides an over-range output up to approximately 5mv where high level outputs are required. The instrument has a sufficiently broad range to test IF's and to sweep discriminators. The precision control of frequency makes for easy testing at specific frequencies such as those at the 3db points.

1.7 PLUG-IN MODULES (Optional Equipment).

1.8 Typical plug-ins are: the Meter Deviation Module (MDM-1) and the Oscilloscope Deviation Module (Model ODM-1). The modules are installed in the front panel and require no rewiring or rework.

1.9 Model MDM-1 provides accurate generation and measurement of FM signals. Total amount of deviation is read directly on the front panel and recovered audio is fed to the built-in speaker. An output from the discriminator circuit of the meter is provided should visual presentation of recovered audio be required. Internal and external modula - tion signals can be combined by means of a mixing circuit for receiver checkout.

1.10 Module ODM-1 combines an oscilloscope and a discriminator circuit for precision measurements of deviation. A built-in FM modulator combines external and internal modulation signals for receiver checkout.

TABLE 1-1. SPECIFICATIONS

FREQUENCY RANGE	Generate (Leveled)	100KHz to 500MHz (Useable to less 50KHz)
	Generate (Unleveled)	50Hz to 5KHz 500MHz to 1GHz
	Measure	50KHz to 1GHz
FREQUENCY RESOLUTION	Synthesized Mode	1KHz
	Variable Decade	10Hz = 1/2 Div.
VARIABLE DECADE RANGE	Normal	0 - 1KHz
	1KHz Decade	0 - 10KHz
	10KHz Decade	0 - 100KHz
	100KHz Decade	0 - 1MHz
FREQUENCY ACCURACY	Synthesized Mode	0.0001% (1 ppm), -5^{o} to $+50^{o}C$
	Variable Decade	0.0001% ±50Hz at $25^{o}C$, T/C=2Hz/^{o}C(max)
	Warm-up Time	"Instant On"
FREQUENCY STABILITY	Residual FM	Less than 100Hz
	Long Term Drift (Ageing)	1 ppm/year
RF OUTPUT	Range: Calibrated sector of variable attenuator	0.05 to 500 μV (50Ω) with external attenuators supplied
	Range: Uncalibrated sector of variable attenuator	500 μV to 2.5 mV (50Ω)
	Accuracy	± 3db at 0.5 μV (mid-range)
	Leakage	Less than 0.15 μV measured at 18" from instrument

TABLE 1-1. SPECIFICATIONS (CONT)

MEASURE INPUT SENSITIVITY	50KHz to 1MHz	Less than 50 mV rms
	1MHz to 500MHz	Less than 3 mV rms -29dB (8 min) typ
	500MHz to 1GHz	Less than 200 mV rms
ZERO BEAT INDICATION	Visual	Meter for beat notes less than 5Hz
	Audio	Built-in speaker and phone jack
MODULATION	FM	Supplied by MDM-1, ODM-1 or AFM-1 (accessory) modules
	AM	Supplied by AFM-1)accessory) modules
OPERATING VOLTAGE	AC	115/230 vac 50 to 400Hz at 30VA max, without plug-ins
	DC	11.5 to 15 volts at 2 amp maximum without plug-ins
OPERATING TEMPERATURE RANGE		– 5 to + 50°C
WEIGHT		34 pounds without plug-ins
DIMENSIONS		8-3/4"H x 12-1/2"W x 5-5/16"D
RFI		Designed to meet MIL-I-6181D

SECTION II
OPERATING INSTRUCTIONS

2.1 GENERAL

2.2 Section II presents full instructions for connecting to a power source, making frequency measurements and generating output signals. Refer to Table 2-1 for explanation for the functions of all controls, indicators and connectors.

2.3 Operation of Model FM-10 is extremely simple and does not involve calibration or locking procedures. Any desired frequency is obtained with full rated accuracy when the power is switched on and the frequency controls are set to the specified value.

2.4 POWER SUPPLY CONNECTIONS.

a. To use a dc source, 11.5V to 15V:

(i) Connect power to the AC/DC connector.

(ii) Use the special DC cable assembly provided to connect to a car or truck battery.

NOTE

Make certain that the external source provides a negative ground. Reverse polarity will blow the dc fuse. (FM-10 case is connected to the dc negative line).

b. To use a 115VAC source:

Plug power cord into 115VAC 3-pin type source.

NOTE

The FM-10 is supplied pre-set to 115VAC for use in North America, unless otherwise indicated by a decal over the AC/DC socket. Power cord supplied is 3-pin for use with 115V grounded mains supply.

c. To convert to 230VAC operation:

(i) Remove instrument cover by removing four screws on the back.

(ii) Set voltage switch marked "115" to 230V setting. (This switch is located behind left hand panel and is exposed when the instrument cover is removed).

(iii) Replace cover.

(iv) Plug into source.

2.5 START PROCEDURE.

a. Switch on power.

(i) For dc, press POWER switch to OUT/DC position.

(ii) For ac, press POWER switch to IN/AC position.

NOTE

To obtain accuracy of 1×10^{-7}, compare accuracy against higher accuracy standard and adjust TCXO after one hour temperature soak.

2.6 USE AS A FREQUENCY METER

2.7 SET-UP PROCEDURES

2.8 Antenna Set-Up:

Connect antenna provided to MEAS INPUT.

CAUTION

Do not overload the instrument with excessive RF signal. Decrease input level at measure input if required.

2.9 Direct Connection Set-Up.

a. Connect RFA-60, load and unit under test as shown in Figure 2-1.

b. If the FM-10 is overloaded, connect RFA-20 in line between FM-10 and RFA-60.

CAUTION

The transmitter power should not exceed 60 watts.

2.10 MEASURING PROCEDURES.

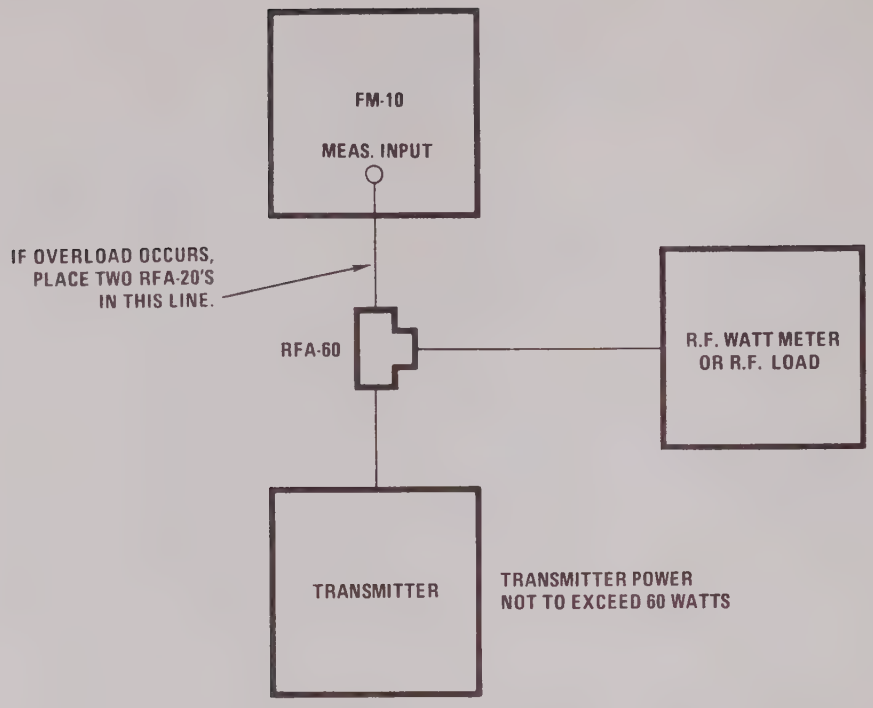


Figure 2-1. Direction Connection, Frequency Measuring Mode

2.11 When the transmitter frequency is within a few hundred hertz of a known channel frequency:

a. Push 10MHz switch to OUT.

b. Push AUDIO switch to IN/BEAT.

NOTE

For remote presentation of beat note, connect a speaker to the AUDIO OUTPUT jack. Use VOLUME control to adjust beat note level. Internal speaker is disconnected when an external unit is connected into the AUDIO OUTPUT jack.

c. Switch decade dials to the channel frequency.

d. Key the transmitter.

e. Observe beat note and reduce it to zero by adjusting the "0–1KHz" decade control. (Ensure that none of the other decade controls are switched to the V position.)

f. Read actual transmitter frequency from decade dials.

2.12 When the transmitter frequency is known only approximately (within a range of one megahertz):

a. Switch the megahertz decade controls (100MHz, 10MHz and 1MHz) to a frequency slightly below the presumed value.

b. Switch the 100KHz control to V.

c. Search for zero beat by turning the "0 – 1KHz" control.

d. Observe zero beat and read off the position of the "0–1KHz" control (the reading is in 100KHz per division).

e. Switch the 100KHz control to the value obtained in (d).

f. Turn 10KHz control to V.

g. Repeat steps (c) and (d). (The reading is 10KHz per division.) Switch the 10KHz control to the value obtained.

h. Turn 1KHz control to V.

i. Repeat steps (c) and (d). (The reading is in 1KHz per numbered division.)

j. Switch the 1KHz control to the value obtained in (i).

k. Turn "0–1KHz" control until zero beat is obtained on the beat meter.

l. Read off exact frequency from all seven decade controls.

2.13 USE AS A SIGNAL GENERATOR. (CW signal only).

2.14 SET-UP PROCEDURE.

a. Push 10MHz switch to OUT.

b. Make output connection to RF OUTPUT.

c. For readout in the range 0.05 to 5 microvolts, connect as shown in figure 2-2. The RF OUTPUT control is calibrated for use with two RFA-20 attenuators in circuit. For readout in the 5 – 500 microvolt range, remove the attenuators and multiply scale reading X 100.

d. Dial channel frequency on the decade switches.

e. Adjust signal level with RF OUTPUT control.

CAUTION

Do not key the transmitter while directly connected to FM-10. Keying will burn out the RFA-20 attenuator. If the 40db attenuation is not used and the transmitter is accidentally keyed, a built-in pad behind the input connector to the FM-10 will be destroyed.

2.15 MANUAL FREQUENCY SWEEP PROCEDURE.

2.16 Set-up base frequency and output level as described in 2-14.

2.17 To manually sweep 1MHz:

a. Switch 100KHz control to V.

b. Rotate "0–1KHz" control through its full range. The output frequency will increase by 1MHz.

2.18 To manually sweep 100KHz:

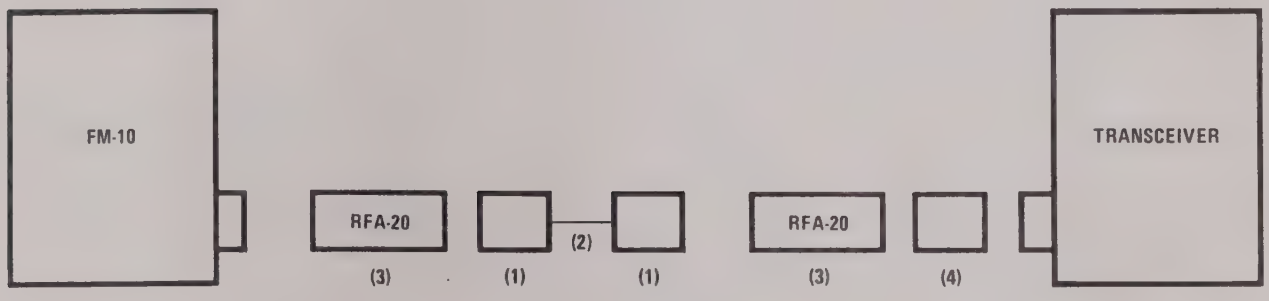
a. Switch 10KHz control to V.

b. Rotate "0–1KHz" control through its full range. The output frequency will increase by 100KHz.

2.19 To manually sweep 10KHz:

a. Switch 1KHz control to V.

b. Rotate "0–1KHz" control through its full range. The output frequency will increase by 10KHz.



ITEM	DESCRIPTION
1	BNC Connector male
2	RG - 58U Coax cable
3	RFA-20 Attenuator
4	BNC to UHF Adapter, UG - 273/U

Figure 2-2. Connections for Signal Generator Mode, Using Two RFA-20s.

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	100MHz Dial Marking 0-1-2-3-4	Rotary Switch – 5 positions	Controls frequency in four steps of 100MHz
2	10MHz Dial Marking 0-1-2-3-4-5-6-7-8-9	Rotary Switch – 10 positions	Controls frequency in ten steps of 10MHz
3	1MHz OFFSET 2MHz for MOD MEAS Dial Marking 0-1-2-3-4-5-6-7-8-9	Rotary Switch – 10 positions	Controls frequency in ten steps of 1MHz
4	100KHz WIDEBAND FM "V" POSITION Dial Marking 0-1-2-3-4-5-6-7-8-9-V	Rotary Switch, 11 positions	Controls frequency in 10 steps of 100KHz. "V" position switches 0-1KHz control (item 7) into circuit with continuous control over range of 1MHz.
5	10KHz NARROWBAND FM "V" POSITION Dial Marking 0-1-2-3-4-5-6-7-8-9-V	Rotary Switch, 11 positions	Controls frequency in ten steps of 10KHz. "V" position switches the 0-1KHz control (item 7) into circuit with continuous control over range of 100KHz.
6	1KHz Dial Marking 0-1-2-3-4-5-6-7-8-9-V	Rotary Switch, 11 positions	Controls frequency in 10 steps of 1KHz. "V" position switches the 0-1KHz control into circuit with continuous control over range of 10KHz.
7	0-1KHz Dial Marking 0-1-2-3-4-5-6-7-8-9-10-OUT	Potentiometer / Switch	Controls frequency continuously over four ranges: 0-1KHz 0-10KHz (1KHz control in V position) 0-100KHz (10KHz control in V position) 0-1MHz (100KHz control in V position) Frequency range of this potentiometer is 0-1KHz when switches 1KHz, 10KHz and 100KHz are not in "V" position.
8	MEAS INPUT	Connector, BNC Female	Input connector
9	BEAT METER	Meter	Follows positive voltage excursion of beat note. Provides visual indication of beat note frequency when frequency is less than 5Hz.
10	RF OUTPUT (X 100 WITHOUT PAD)	Attenuator scaled in db's and microvolts with uncalibrated "HI" range.	Controls R.F. output. Scale markings are based on use of 40db external attenuators. If no external attenuator is used, multiply millivolt scale reading by X 100.

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (CONT)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
11	PWR IN/AC -- OUT/DC	Switch, pushbutton	Controls power supply. Push to IN position for AC. Push to OUT position for DC.
12	10MHz, IN OUT	Switch, pushbutton	Applies 10MHz signal direct from TCXO crystal to detector. Produces audio frequency at phone jack with same accuracy as TCXO.
13	AUDIO IN / BEAT OUT / MOD	Switch, pushbutton	Switches loudspeaker into beat detector circuit. This switch should be in the IN position at all times except when a plug-in module is used.
14	VOLUME	Potentiometer	Controls speaker volume and output at AUDIO OUTPUT connector.
15	AC / DC	Connector, socket	Provides connection to AC or DC source.
16	AC	Fuse	Protects 115/230 VAC input circuits.
17	DC	Fuse	Protects DC input circuit.
18	AUDIO	Connector, phone jack	Supplies audio output signal
19	RF OUTPUT	Connector BNC Female	Supplies calibrated output controlled by RF OUTPUT attenuator.

SECTION III
THEORY OF OPERATION

3.0 LEFT HAND MODULE A1

Assembly A1 contains the input filter assy, the divider and automatic level control board A1A2, the power supply, AF and IF amplifier board, A1A3, the broadband amplifier board, A1A4, the beat meter, loudspeaker and fixed and variable RF output attenuators.

3.1 RF OUTPUT CIRCUIT

The fully synthesized frequency provided by the synthesizer section of the FM-10 is supplied from low-pass filter FL3 on assembly A9 to the broadband output amplifier on board A1A4 via Pin 5. The amplifier output is supplied via variable attenuator AT2 to J2, the RF output connector.

3.2 BROADBAND AMPLIFIER (A1A4)

The broadband amplifier on A1A4 receives the output of the FM-10 frequency synthesizer which is supplied via Pin 5 on A1A4. The synthesized frequency is amplified by Q1, Q2, and Q3 and appears at the BNC connector J9.

3.3 "MEASURE INPUT" CIRCUIT

The input signal is supplied via front panel connector J1 (MEAS INPUT) to a detector CR2 on assembly A1A4 which acts as a mixer. The input signal is mixed in CR2 with the synthesized frequency generated by the FM-10 supplied from the broadband output amplifier. The output of the mixer is supplied via Pin 7 on A1A4 to IF amplifier Q6 on A1A3. The output of the mixer may be an audio beat note or the 2 MHz IF signal carrying modulation which is supplied to the right-hand plug-in module (such as the MDM-1 or ODM-1) where it is demodulated. The audio output of A1A3-Q6 is supplied to the audio preamplifier consisting of Q7 and Q8 (on A1A3) and then via Pin 10 to the beat note selector switch S11. When S11 is in the BEAT (IN) position the beat note appears at loudspeaker LS1 and beat meter M1 following amplification by the audio amplifier consisting of Q9, Q10, and Q11. The MOD (OUT) position of S11 switches the beat meter and loudspeaker circuit to the demodulated audio output of any plug-in module which is inserted in the right-hand compartment.

3.4 AUTOMATIC LEVEL CONTROL

Automatic levelling of the output of the frequency synthesizer portion of the FM-10 is effected by means of detector CR1 on A1A4, the automatic level control amplifier on A1A2 and the gain control amplifier on A7. The detector CR1 supplies a dc voltage proportional to the amplitude of the output of the broadband output amplifier on A1A4. The dc output is supplied to the ALC amplifier on A1A2 via Pin 13. This dc amplifier consists of U5, U6, Q6, Q7, and Q8. Transistors Q7 and Q8 and the voltage rectifier consisting of CR4 and CR5 take a 1 MHz signal supplied from Q4 and rectify it to provide a negative dc voltage, for use in the ALC circuit. This negative voltage appears at the junction of A1A2-R39 and A1A2-C27. According to the level of the synthesized output signal sensed by detector CR1 on assembly A1A4, the output signal produced by automatic level control circuit on A1A2 at Pin 15 is a dc voltage proportional to the carrier signal level. The output signal at Pin 15 is routed to the gain control amplifier on assembly A7 via Pin 1 and the rear panel connector J10.

3.5 DIVIDER CIRCUIT (A1A2)

Three standard frequencies (100 KHz, 1 MHz, and 2 MHz) for use in other sections of the FM-10 are derived by the divider on A1A2 from a 10 MHz input signal (10 MHz No. 2) supplied from Pin 24 of rear panel connector J10. This 10 MHz signal is supplied directly from the TCXO on A11. (It should be noted that this 10 MHz signal becomes the 10 MHz No. 3 signal which appears at Pin 3 of A1A2. The No. 3 10 MHz signal can be supplied as a substitute input signal to the Measure Input circuit if an external input signal is not available. It is selected by front panel switch S10.)

The 10 MHz No. 2 is amplified by Q1 and Q2 to drive the J-K type flip flops U1, U2, U3, and U4 in dual in-line DIP packages. The flip flops provide qui-binary (divide by 5, divide by 2) division. The U3 and U4 flip flops derive a 1 MHz signal which is supplied via emitter follower Q4 to Pin 9 of A1A2. The output of the divide-by-5 flip flop U4 is a 2 MHz signal which is supplied via emitter follower Q5 to Pin 11.

Another 1 MHz output signal from U3 is supplied to the decade divider consisting of U1 and U2 which derives a 100 KHz output isolated by emitter follower Q3 and appearing at Pin 7 of A1A2.

3.6 POWER SUPPLY (A1A3)

The power supply consists of the 9-volt regulator comprising Q3, Q4, and Q5 and a 12-volt regulator consisting of Q1. Overvoltage is prevented by the protection circuit containing Q2 and CR3. (Transistor Q1 mounted on the rear of the left-hand module for heat sink purposes acts as a series pass regulator).

3.7 VOLTAGE-CONTROLLED OSCILLATOR (VCO) BOARD (A2)

The voltage-controlled oscillator Q1 which provides the 0-1 KHz component of the final synthesized frequency is controlled by a dc voltage derived from variable resistor R1 which is the front panel 0-1 KHz control. The dc voltage varies the capacitance of Varicaps CR1 and CR2 which provide a tuning range of 5 to 6 MHz. The output signal of the oscillator circuit is amplified by Q9 and Q8 and the amplified output signal appears at Pin 5. The 5-6 MHz output of the VCO board is switched to the 100 KHz, 10 KHz or 1 KHz decade when any of these decade switches are at the V position.

When the 0-1 KHz control S7 is at the OUT position, the VCO is out of circuit and the 6 MHz signal supplied from Pin 9 of A2 is routed to the 1 KHz, 10 KHz and 100 KHz decades.

Another function of the VCO is to provide FM modulation. When a plug-in module, which can supply an audio modulating tone, is installed, the audio signal is supplied via Pin 6 of A2 to the Varicaps and modulates the 5 to 6 MHz output signal of the VCO. The audio modulating signal at Pin 6 comes from the plug-in via the left-hand module rear connector J11.

Also on the VCO board A2 are two multiplier circuits which generate standard frequencies for use in other sections of the instrument.

The circuit consisting of Q1, Q2, Q3, and Q4 derives a 9 MHz signal from the 1 MHz input at Pin 3 supplied via the rear panel connector P10, from A1A2. Q1 is a shaper stage, Q2, Q3, and Q4 are amplifiers tuned to the 9th harmonic of 1 MHz.

The circuit consisting of Q5, Q6, and Q7 derives a 6 MHz signal from the 2 MHz input appearing at Pin A2-8 supplied via the rear panel connector P10 from A1A2. Q5 is multiplier stage tuned to the third harmonic of 2 MHz. Q6 and Q7 provide amplification.

3.8. 1 KHz DECADE, A3

The 1 KHz decade consists of a decade divider (U1 and U2), a summing mixer (U3 and U4), a filter (C12-C16, L1,L2) a difference mixer (U5 and U6) and an amplifier (Q2, Q3, and Q4).

The input signal to the divider is the 5-6 MHz output of the VCO circuit on A2. It appears at Pin 3 of A3. Amplifier Q1 and dc restorer CR1 provide the input to the divider, U1 and U2, a qui-binary circuit. The output of the divider is supplied to the balanced mixer, U3 and U4. The summing mixer has a second input at Pin 6, the 9 MHz signal from board A2. Thus the output of the mixer is 9.5 to 9.6 MHz. This is filtered and supplied to difference mixer U5 and U6, where it is mixed with any one of the ten standard frequencies 3.6 to 4.5 MHz selected by switch S6 and supplied to the mixer via Pin 8. The ten standard frequencies in the range 3.6 to 4.5 MHz are derived from the frequency generator boards A12 through A21.

Thus the output of the mixer (U5 and U6) has a range of 5 to 6 MHz. This is amplified and filtered by Q2, Q3, and Q4 and filter FL1 and supplied to Pin 9 of A3. The output of the 1 KHz decade therefore varies from 5 to 6 MHz in 100 KHz steps.

3.9 10 KHz DECADE, A4

The 10 KHz decade is identical to the 1 KHz decade, A3, with the sole exception that the output of the 1 KHz decade is the input to the 10 KHz decade. The second and third inputs of 9 MHz and 3.6 to 4.5 MHz at Pins 6 and 8 are also identical. The output of the 10 KHz decade is 5 to 6 MHz in 100 KHz steps.

3.10 100 KHz DECADE, A5

The 100 KHz decade is also identical to the 1 KHz decade A3 and the 10 KHz decade A4 with the sole exception that its input is the output of the 10 KHz decade, A4. The output range of the 100 KHz decade is 5-6 MHz in 100 KHz steps.

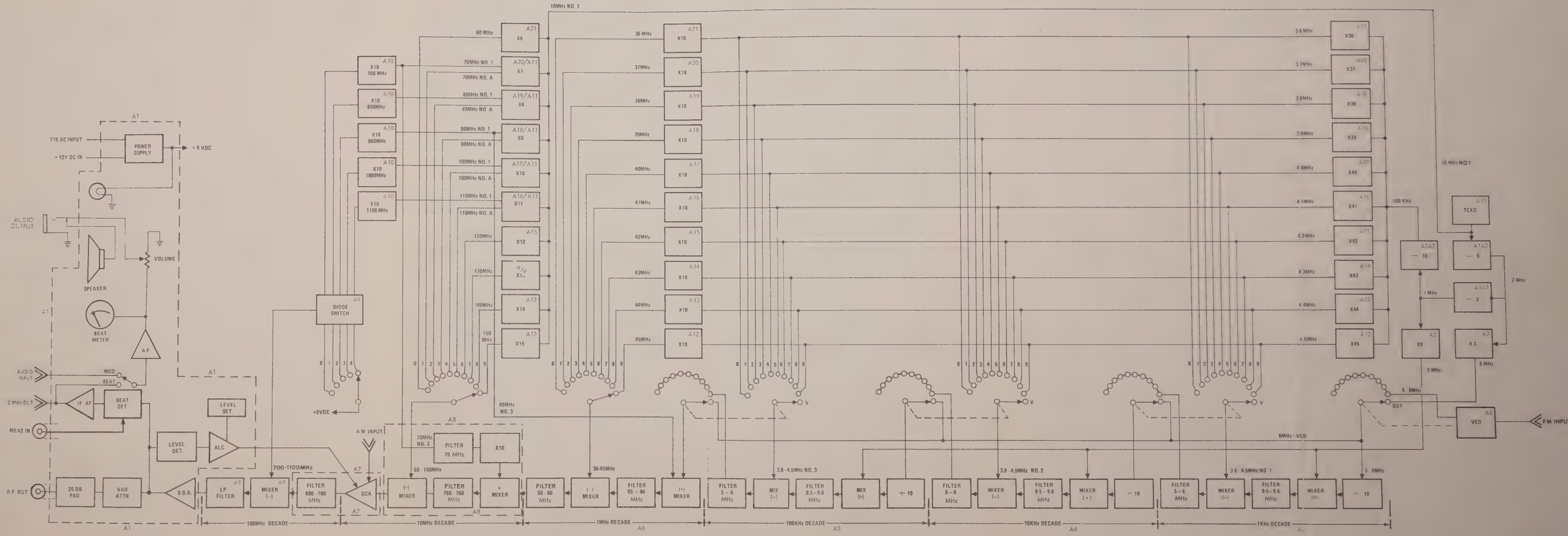


Figure 3-1. Overall Block Diagram

3.11 1 MHz DECADE, A6

This is a mixer stage with three inputs and one output. The inputs are a 5 to 6 MHz signal at Pin 6 from the 100 KHz decade, a 90 MHz signal at Pin 4 and a 36 to 45 MHz signal at Pin 14. The output has a range of 50 to 60 MHz in 1 MHz steps.

The 5-6 MHz input at Pin 6 of A6 is applied to emitter follower Q2 and then to balanced mixer A1. The other input to the mixer is the 90 MHz signal amplifier by Q1. The two inputs are summed, amplified by Q3 and Q5, filtered by FL1, mixed with a 36-45 MHz input in difference mixer A2 giving an output in the range 50-60 MHz. This is amplified by Q6 and Q4, filtered by FL2 and supplied to Pin 8 of A6.

3.12 10 MHz DECADE, A8

The 10 MHz decade is a mixer stage with three inputs and one output. The inputs are 70 MHz at Pin A8-5, 50-60 MHz at Pin A8-3, and 60-150 MHz to mixer Z2 located on A8. The output is a 600-700 MHz signal from mixer Z2 which is applied to the Gain Control Amplifier, A7.

The 50-60 MHz input at Pin A8-3 is derived from the 1 MHz decade A6. This is applied to double balanced summing mixer Z1. The other input to Z1 is a 700 MHz signal derived from the 70 MHz input at Pin A8-5. The 70 MHz is filtered by the LC network, applied to harmonic generation diodes CR1 and CR2 and amplified by Q1 which is tuned to the fifth harmonic. The output of Q1 is amplified by Q2 and applied to Q3 which is tuned to the second harmonic of its input giving an overall multiplication of 10. Q4 is a buffer amplifier to drive mixer Z1. Thus the output of summing mixer Z1 is 750-760 MHz which is amplified by Q7, Q6, and Q5 and filtered by filter FL1. The output of the filter FL1 is applied to difference mixer Z2 together with the 60-150 MHz signal selected by the 10 MHz decade control. The output of Z2 is a 600 to 700 MHz signal varying in 10 MHz steps. This is supplied to the gain control amplifier located on board A7.

3.13 GAIN CONTROL AMPLIFIER, A7

The input to the gain control amplifier on A7 is derived from the 10 MHz decade on board A8 and consists of a signal in the range 600-700 MHz varying in 10 MHz steps. The signal is supplied to the board at Pin 4 and is amplified by amplifiers Q8 and Q9 the gains of which are controlled by the signal appearing at Pin 1 derived from the automatic level control amplifier on board A1A2. The signal is then applied to diode modulator Q10 and Q11 and passes through filter FL2 via Pin 6. The diode modulator consisting of Q10 and Q11 provides amplitude modulation of the signal when a modulating signal is supplied from a plug-in module via the rear panel connector J11. The output signal of assembly A7 is routed to filter Z1 on assembly A9.

3.14 DIODE SWITCH, MIXER, LOW PASS FILTER, A9

The 600-700 MHz output signal from filter FL2 on assembly A7 is supplied to double balanced difference mixer Z1 on assembly A9. Here it is mixed with a 700 to 1100 MHz signal selected by front panel switch S1 (100 MHz decade control) which operates the diode switch circuits consisting of CR1, CR2, CR3, CR4, and CR5. The application of +9 VDC via switch S1 causes one of the diodes to conduct, thus supplying a frequency in the range 700-1100 MHz to mixer Z1. The products of mixing lie in the range 0-500 MHz, but the output circuit of mixer Z1 is limited to the range 50 KHz to 500 MHz. The output signal of the mixer is filtered by low pass filter FL3 and supplied to the broadband output amplifier on assembly A1A4 via connector A1A4-J5.

3.15 100 MHz DECADE, A10

Assembly A10 consists of five multiplier-amplifier chains which provide standard frequencies (700, 800, 900, 1000, and 1100 MHz) to the diode switch circuits on assembly A9.

The input signals to the five chains consist of five frequencies: 70, 80, 90, 100 and 110 MHz. These are also standard frequencies derived from the buffer amplifiers on assembly A11.

The 70 MHz input is supplied to Pin 1 of A10 and passes through harmonic generators CR1 and CR2, and then to the multiplier Q1 which is tuned to the fifth harmonic, 350 MHz. The signal is then amplified by buffer amplifier Q2 and doubled in frequency by multiplied Q3 tuned to 700 MHz. Further amplification is provided by Q4.

The 80, 90, 100 and 110 MHz signals are all multiplied in identical fashion in the remaining four chains on assembly A10.

3.16 TCXO AND BUFFER AMPLIFIER, A11

The buffer assemblies consist of Q1, Q2, Q4, Q6, Q7, and Q8. The input signals to these stages consist of the frequencies: 70, 80, 90, 100 and 110 MHz. These are derived from frequency generation assemblies A16 to A10. The

output signals of Q1, Q4, Q6, Q7, and Q8 are supplied to the multipliers on assembly A10. The 70 MHz output of buffer Q2 is supplied to the 10 MHz decade on assembly A8.

The other section of assembly A11 contains subassembly A11-A1, the 10 MHz TCXO crystal which is the prime frequency standard from which all others in the FM-10 are derived. Transistors Q3 and Q5 provide two amplified 10 MHz outputs at Pin 36 and 39. One output is supplied to assembly A18 and the other to the left-hand module A1 via rear panel connector J10.

3.17 FREQUENCY GENERATOR ASSEMBLY (4.5, 45 and 150 MHz) A12

Assembly A12 generates frequencies 4.5, 45 and 150 MHz for use in three separate sections of the FM-10. There are two standard frequency input signals of 100 KHz and 10 MHz. The output frequencies of 4.5 and 45 MHz are derived by a successive multiplication from the 100 KHz signal. The 150 MHz output is derived from the 10 MHz input by means of a X15 multiplier.

The 100 KHz input signal to assembly A12 is generated on assembly A1A2 by the divider circuitry. The 100 KHz output of A1A2 is supplied to assemblies A12 through A21 by a direct line to assembly A18 and then by crosspatching to the other assemblies.

The 100 KHz signal is supplied to multiplier Q1 which is tuned to the 45th harmonic, 4.5 MHz. Transistor Q2 and crystal Y2 form a 4.5 MHz filter. The integrated circuit U1 provides amplification and limiting and emitter follower Q8 provides further amplification and isolation. The output of 4.5 MHz appears at Pin 23. A further 4.5 MHz output is taken from U1 at the junctions of Pins 11 and 14 and supplied via crystal Y1 to shaping circuit Q3, to multiplier Q4 tuned to the 10th harmonic, 45 MHz. Transistors Q7 and Q8 are tuned amplifiers. The 45 MHz output appears at Pin 20.

The third multiplier on assembly A12 derives the 150 MHz output from the 10 MHz input appearing at Pin 9. The 10 MHz signal is shaped by transistor Q5 and multiplied by Q6 which is tuned to the 15th harmonic, 150 MHz. Transistor Q10 and Q11 provide amplification and filtering.

3.18 FREQUENCY GENERATOR ASSEMBLIES A13 to A21

• Assemblies A13 to A21 are identical to assembly A12 with the exception of the magnitudes of the frequencies generated.

Frequencies generated:

A13	4.4, 44 and 140 MHz
A14	4.3, 43 and 130 MHz
A15	4.2, 42 and 120 MHz
A16	4.1, 41 and 110 MHz
A17	4.0, 40 and 100 MHz
A18	3.9, 39 and 90 MHz
A19	3.8, 38 and 80 MHz
A20	3.7, 37 and 70 MHz
A21	3.6, 36 and 60 MHz

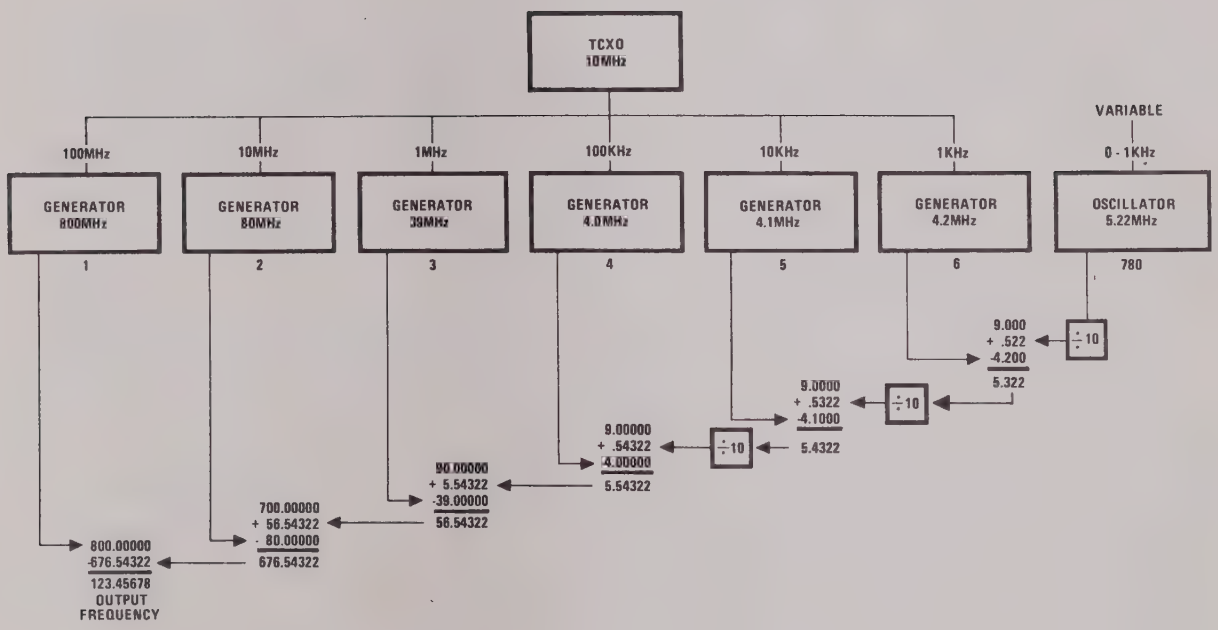


Figure 3-2. Typical Frequency Synthesis

SECTION IV
MAINTENANCE

4.0 GENERAL

4.1 This section contains information for the maintenance of the Model FM-10 frequency meter/signal generator. Included are in-cabinet performance checks, troubleshooting procedures and adjustments.

4.2 Test equipment. For the list of equipment required for maintenance of Model FM-10, see Table 4-1.

TABLE 4-1

LIST OF TEST EQUIPMENT REQUIRED FOR IN-CABINET PERFORMANCE TESTS, TROUBLESHOOTING AND ADJUSTMENTS

1 Spectrum Analyzer – Singer Model SA-70 or equivalent.

2 Oscilloscope – Tektronix Model 454 or equivalent.

3 RF Voltmeter – Millivac Model MV-928A or equivalent. (with 50Ω Termination).

4 Multimeter – Simpson Model 260 or equivalent.

5 FM-10 Patch Cables – PC2652 (for LH Module) and PC-2653 (for RH module).

6 Kay Amp Model 1024A or equivalent.

7 Counter – HP Model 5532A or equivalent.

8 1 MHz Frequency Standard.

9 Signal Generator – HP 608 or equivalent.

10 Plug-In modules MDM-1 or ODM-1 and AFM-1.

11 Audio Oscillator – HP 651A or equivalent.

4.3 In-Cabinet Performance Checks.

The in-cabinet performance checks verify that the Model FM-10 is operating within specifications. These checks may be used as part of incoming quality control inspection, as a periodic operational check and following repairs or adjustments.

4.3.1 Frequency synthesis and spurious response check.

a) Connect RF output jack of Model FM-10 to the input of the spectrum analyzer. Set the Model FM-10 frequency to 10.0 MHz. Center the trace on the analyzer.

b) Set the dispersion of the analyzer to 10 KHz/division; adjust the variable attenuators of the analyzer and the FM-10 to give almost full scale on the analyzer.

c) Switch the Model FM-10 10 KHz decade control from 0 through 9 and note that the frequency changes approximately 1 division for each switch position. Also note that the spurious responses are at least 35 dB down. Return the 10 KHz decade control to 0.

d) Increase the spectrum analyzer dispersion to 100 KHz/division and move up to the next frequency decade on the Model FM-10 and repeat step 4.3.1c for all the remaining decades. The spurs should be at least 35 dB down 10 MHz above and below the center frequency.

e) Set the Model FM-10 controls:

10 MHz switch	IN
VOLUME	Fully CW
Frequency Controls	010.0000
AUDIO	IN/BEAT

f) Turn the 1 KHz decade switch from the 0 position to the 9 position. The tone frequency should increase at each switch position.

4.3.2 FM Modulation Check.

a) Install Model MDM-1 or ODM-1 plug-in module. Set up FM-10 and plug-in for 15 KHz deviation as described in the plug-in module instruction manual.

b) Observe deviation reading on the MDM-1 meter or the ODM-1 screen. Is 15 KHz, if so, the FM-10 is modulating properly.

4.3.3 Amplitude Modulation Check.

a) Install in the AFM-1 plug-in module in the FM-10 mainframe.

b) Set the FM-10 frequency to 5 MHz. Set the Model H.P. 651A test oscillator to 1 KHz and connect the 50 OHM output of the Model 651A to the AM jack of the AFM-1 plug-in.

c) Connect the Tektronix Model 454 scope vertical input to the FM-10 RF output jack and the ext trig input to the test oscillator.

d) Turn the FM-10 RF output control fully CW and adjust the gain of the oscilloscope for a useable display.

e) Adjust output of the test oscillator and adjust scope to verify that approximately 30 percent modulation may be obtained.

4.4 TROUBLESHOOTING PROCEDURE.

4.4.1 To locate trouble in the Model FM-10, remove instrument covers and make visual inspection with power off. Proceed to electrical checkout as necessary. During the visual inspection look for burned or loose components, loose wire connections or any signs which suggest possibilities of trouble. Repair any faulty component or connection revealed by the initial inspection before proceeding to the steps below.

4.4.2 Power Supply Checks.

4.4.2 The three checks below (4.4.4 through 4.4.7) indicate power supply problems. If the result of any of the checks is negative, the fault should be located and rectified before continuing with other troubleshooting checks.

4.4.4 With power off, remove left hand module and reconnect connectors P10 and J10 via patch cable PC2652.

4.4.5 With power off, measure resistance to ground from junction point of red wires on A7 (see figures 4-1 and 6-6). The value should be greater than 20 ohms. If not, there is a short in the power supply.

4.4.6 Switch on power and measure voltage (B+) at junction point of red wires on A7. Value should be 9V ± 0.5%.. Adjust A1A3R10 for this voltage. If the correct voltage cannot be obtained, continue investigation of power supply until fault is rectified.

4.4.7 Measure resistance to ground of the case of transistor Q1 mounted on chassis, rear of left hand module compartment (see figure 6-2). Value should be greater than 50 K ohms.

4.4.8 Only when the results of the above power supply checks are positive, proceed to following checks.

4.4.9 Broad Band Amplifier (A1A4) Check. (see figure 6-1)

4.4.10 Disconnect BND connector A1P9 and connect RF voltmeter to output of broad band amplifier (A1J9).

4.4.11 Set Frequency controls of FM-10 to 200 MHz.

4.4.12 Output voltage level of broad band amplifier should be -23 dBm ± dB.

4.4.13 Disconnect BNC connector A1A4-P5 (output of 100 KHz-500 KHz low pass filter A9FL-3) and connect to RF voltmeter. Output voltage level should be -33 dBm, ±3 dB. (use 50Ω termination on voltmeter).

4.4.14 Disconnect BNC connector P (L) from mixer Z1(600-700 MHz filter (A7FL-2) output) and connect the RF voltmeter. Output voltage level of 600-700 MHz filter should be -13 dBm minimum. (Use 50Ω termination on voltmeter).

4.4.15 Disconnect BNC connector P (R) from mixer Z1 and connect to RF voltmeter. Turn 100 MHz frequency control to "0" position. Output voltage level of diode switch should be +5 dBm or greater. Measure same voltage with 100 MHz frequency control in positions 1, 2, 3, and 4. (Use 50Ω termination on voltmeter).

4.4.16 Disconnect BNC connector P (I) from mixer Z2 and connect to RF voltmeter. Voltage level should be 0 dBm +1 dBm and for all positions of the 10 MHz decade. (Use 50 Ω termination on voltmeter).

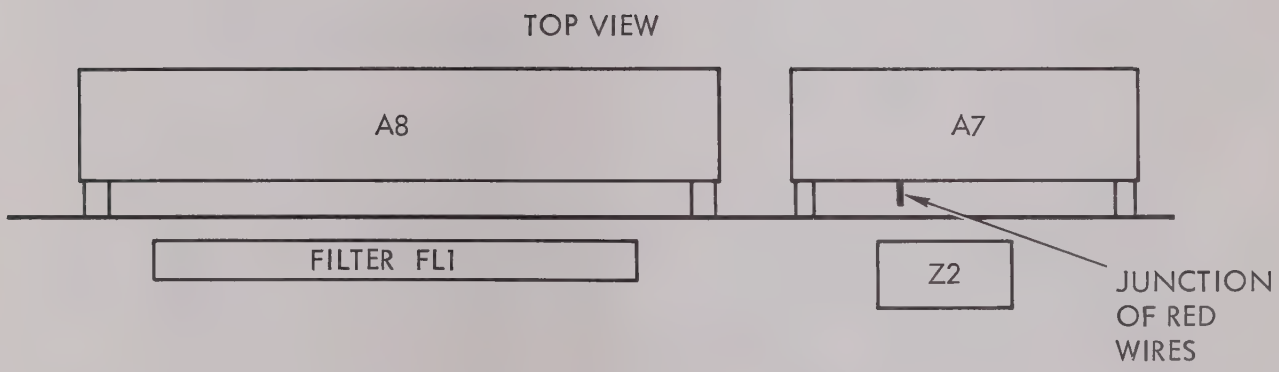


Figure 4-1. Junction Point, A7

4.4.17 Disconnect BNC connector P (R) from mixer Z2 and connect RF voltmeter. (Use 50Ω termination on voltmeter). Voltage level should be greater than +3 dBm.

4.4.18 Connect oscilloscope to output of filter A6-FL2 (50-60 MHz) (see figure 6-5). Turn 1 MHz and 100 KHz frequency controls to "0" position. Output voltage should be greater than 600 mV p-p. Turn 1 MHz frequency control from 0 to 9 position observing same voltage reading at each intermediate position. Turn 100 KHz control from 0 to 9 position observing same voltage reading at each intermediate position.

4.4.19 Connect R voltmeter to terminal I on mixer A6A2. Voltage level should be -10 dBm ±1 dB.

4.4.20 Connect oscilloscope to test point TP3 on board A5 (see figure 6-4). Turn 100 KHz, 10 KHz and 1 KHz frequency controls to "0" positions. Voltage should be 2V p-p. Turn 100 KHz control from 0 through 9 positions observing same voltage at all intermediate positions. Repeat this procedure with the 10 KHz and 1 KHz controls.

4.4.21 Connect oscilloscope to pin A2-5 (5-6 MHz output) on board A2 (see figure 6-3). Turn 0-1 KHz frequency control to "0" position (not OUT). Voltage should be approximately 5-6V p-p. Turn 0-1 KHz control from 0 through 10 and observe same voltage at all points.

4.5 ADJUSTMENTS

4.5.1 All circuit boards may be removed from their mountings by sliding them out sideways (see figures 4-2 and 6-2 for board locations). Most adjustments may be made with each board only half way out of its compartment. When re-inserting boards, dress all wires carefully. Note that some boards cannot be re-inserted unless wires are fully dressed towards the appropriate ends of their compartments.

All internal adjustments described in paragraphs 4.5.2 through 4.5.30 should be made in the sequence given, starting with board A2. The calibration of the TCXO (paragraph 4.6) and the adjustment of the 0-1 KHz control (paragraph 4.7) may be carried out separately.

4.5.2 A2 Board Adjustment (Figure 6-3)

a) Set FM-10 frequency controls to "0" (zero) positions and the 0-1 KHz control to OUT..

b) Lift A2 board and connect the oscilloscope to pin A2-3 (1 MHz input) and ground. The voltage should be approximately 3V p-p.

c) Connect the oscilloscope to pin A2-8 (2 MHz input) and ground. The voltage should be approximately 3.5V p-p.

d) Connect the oscilloscope to pin A2-7 (9 MHz output) and ground. Adjust L1, L2, and L3 on board A2 for maximum output of approximately 600 mV p-p.

e) Connect the oscilloscope to pin A2-9 (6 MHz output) and ground. Adjust A2L4 for maximum output of approximately 4.5V p-p.

4.5.3 A3 Board Adjustment (Figure 6-4)

a) Lift board A3 and connect the oscilloscope to pin A3-3 (6 MHz input) and ground. The voltage should be approximately 5V p-p.

b) Connect oscilloscope to A3-6 (9 MHz input) and ground. The voltage should be approximately 600 mV p-p.

c) Connect oscilloscope to pin A3-8 (3.6-4.5 MHz input) and ground. Voltage should be approximately 600 mV p-p.

d) Measure the voltage at TP1 on board A3 (600 KHz output). Voltage should be approximately 265 mV p-p.

e) Measure voltage at A3-TP2 (9.6 MHz output) and adjust A3R8 for purest waveform. Adjust A3 L1 and A3 L2 for maximum voltage. Voltage should be approximately 235 mV p-p.

f) Measure voltage at A3-TP3 (5-6 MHz output) and adjust A3R23 for maximum output. Switch 1 KHz control from 0 through 9. The voltage should not fall below 2V p-p.

g) Turn the 1 KHz control to 0 and re-install board A3.

4.5.4 A4 Board Adjustment (Figure 6-4)

a) Lift board A4 and connect oscilloscope to pin A4-3 and ground. Voltage should be 2V p-p at 6 MHz.

b) Connect oscilloscope to pin A4-6 (9 MHz input) and ground. Voltage should be 600 mV p-p.

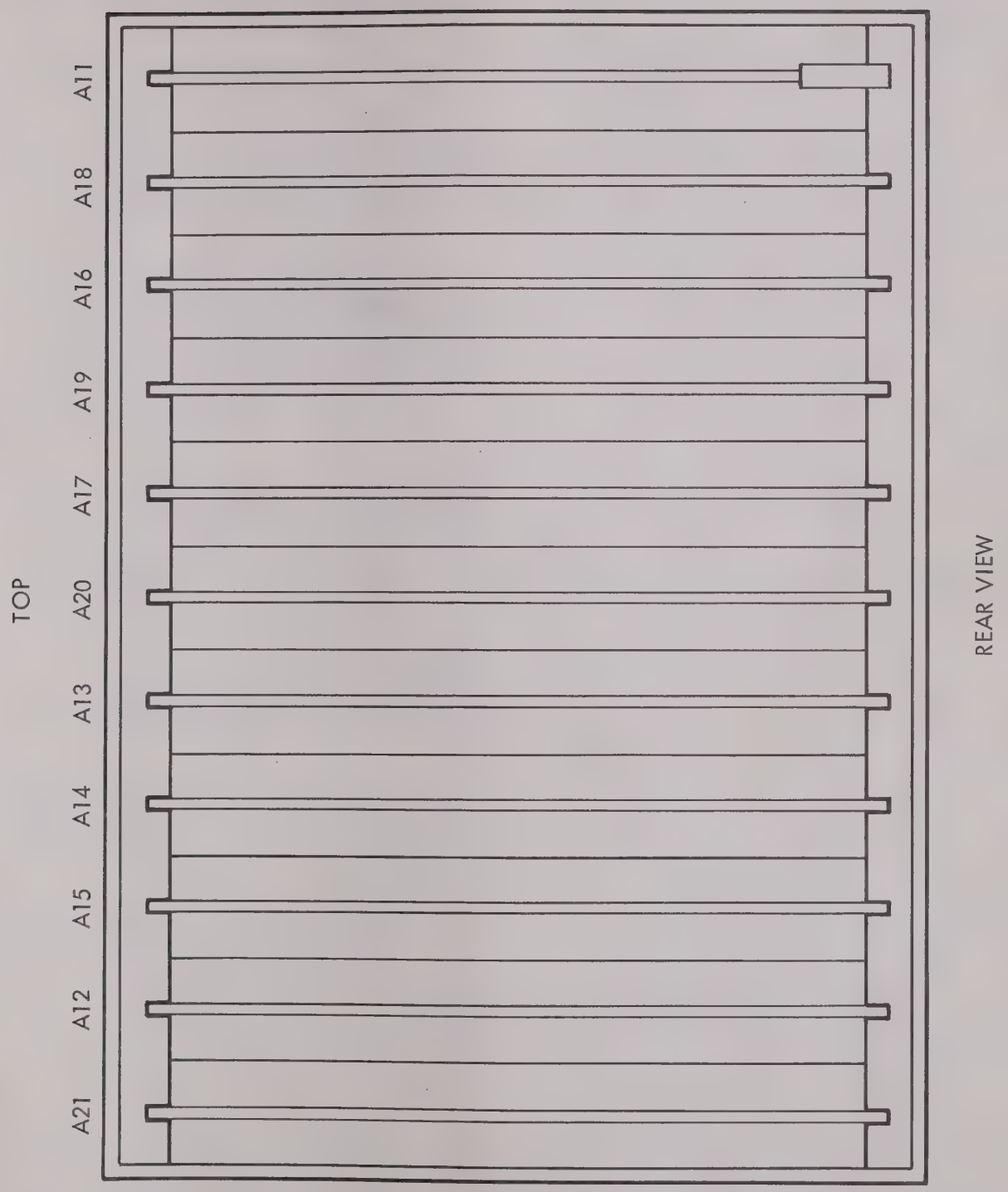


Figure 4-2. Board Locations, A11-A21

c) Connect oscilloscope to pin A4-8 (3.6-4.5 MHz input) and ground. Voltage should be 600 mV p-p.

d) Measure voltage at A4-TP1 (600 MHz output). Voltage should be approximately 265 mV p-p.

e) Measure voltage at A4-TP2 (9.6 MHz output). Adjust A4R8, A4L1 and A4L2 for maximum voltage of approximately 235 mV p-p.

f) Measure voltage at A4-TP3 (5-6 MHz output). Adjust A4R23 for maximum voltage. Turn 10 KHz frequency control from 0 through 9. Voltage should not fall below 2V p-p.

g) Turn 10 KHz to 0 and re-install board A4.

4.5.5 A5 Board Adjustment (Figure 6-4)

a) Lift A5 and connect oscilloscope to pin A5-3 and ground. Voltage should be approximately 2V p-p.at 6 MHz.

b) Measure voltage across pin A5-6 and ground (9 MHz input). Voltage should be approximately 600 mV p-p.

c) Measure voltage across pin A5-8 (3.6-4.5 MHz input) and ground. Voltage should be approximately 600 mV p-p.

d) Measure voltage at A5-TP1 (600 KHz output). Voltage should be approximately 265 mV p-p.

e) Measure voltage at A5-TP2 (9.6 MHz output). Adjust A5R8, A5L1 and A5L2, for maximum voltage of approximately 235 mV p-p.

f) Measure voltage at A5-TP3 (5-6 MHz output). Adjust A5R23 for maximum voltage. Switch 100 KHz frequency control from 0 through 9. Voltage should not fall below 2V p-p;

g) Turn 100 KHz control to 0 and re-install board A5.

4.5.6 A6 Board Adjustment (Figure 6-5)

a) Lift A6 board and conneet oscilloscope to pin A6-6 (5-6 MHz input) and ground. Voltage should be approximately 2-3V p-p.

b) Measure voltage across pin A6-14 (36-45 MHz input) and ground. Voltage should be approximately 200 mV p-p.

c) Measure input voltage to mixer A6A1 Terminal L and adjust A6L1 for maximum amplitude of approximately 1.2V p-p at 90 MHz.

d) Measure output voltage of A6FL-1 and adjust A6L3 and A6L4 for maximum amplitude of approximately 1.2V p-p.

e) Unsolder wire on pin A6-8. Connect the center conductor of a 50 ohm coaxial test cable to pin A6-8 and connect outer conductor to pin A6-9.

f) Connect other end of test cable to RF voltmeter and measure voltage level. Level should be 0 dBm ±3 dB. (Use 50 ohm termination on voltmeter.)

g) Disconnect test cable from RF voltmeter and connect to spectrum analyzer. Set dispersion for 100 KHz with 60 MHz center frequency. Set amplitude to log scale and adjust gain for a dynamic range of at least 40 dB. Proceed with steps 4.5.7 through 4.5.16.

4.5.7 A21 Board Adjustment (Figure 6-10)

a) With 100 KHz and 1 MHz switches in "0" position, pull A21 board out.

b) Connect scope to junction of Y2* and C6*. Tune L1* for maximum amplitude, approximately 100 mV p-p.

c) Observe 60 MHz output on spectrum analyzer and tune C5* for minimum 100 KHz sidebands approximately 40 dB down or greater.

d) While observing spectrum analyzer, tune L3*, L4*, and L5* for maximum output.

e) If output level is other than "0" dBm ±1 dB, select R38*.

*Partial reference designator. Add board assembly number for full designator.

f) Dress all wires above the center of the board toward the top of the chassis and all wires below the center of the board toward the bottom of the chassis, re-install board.

4.5.8 A20 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to number "1" position, pull out A20 board, re-center trace on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

4.5.9 A19 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to "2" position. Pull out A19 board, re-center trace on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

4.5.10 A18 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to "3" position. Pull A18 board, re-center trace on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

4.5.11 A17 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to number 4 position. Pull out A17 board, re-center on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

4.5.12 A16 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to number 5 position. Pull out A16 board, re-center trace on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

4.5.13 A15 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to number 6 position. Pull out A15 board, re-center trace on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

4.5.14 A14 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to number 7 position. Pull out A14 board, re-center trace on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

4.5.15 A13 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to number 8 position. Pull out A13 board, re-center trace on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

4.5.16 A12 Board Adjustment (Figure 6-10)

a) Set 100 KHz and 1 MHz switches to number 9 position. Pull out A12 board, re-center trace on the spectrum analyzer and repeat steps 4.5.7b through 4.5.7f.

b) Set frequency dispersion of spectrum analyzer to 1 MHz. Switch 1 MHz decade from 9 through 0 and note that the frequency change on the spectrum analyzer is linear, 1 div per switch position.

c) Disconnect test coax on A6 and re-install original wires. Push A6 down into its compartment.

d) Disconnect BNC on "I" port (center connector) of Z2 and connect the BNC to the Millivac. (use 50 ohm termination on voltmeter.) With the 100 and 10 MHz switches in "0" position the output should be "0" dBm ±1 dB.

4.5.17 A21 Board Adjustment (Figure 6-10)

a) Pull A21 board half way out and adjust C24* and C36* for maximum output on Millivac.

b) If the output is too high or low, remove the cover and re-tune C24* and C36*.

c) If the output is too high, un-solder and move the tap on L7* down toward ground until the output is "0" dBm, re-peak C36* after soldering the tap back on the coil.

d) If the output is too low, un-solder and move the tap on L7* up until the output is "0" dBm, re-peak C36* after soldering the tap back on the coil.

e) Re-install the cover and re-peak C24* and C36*, push the board back into the compartment.

*Partial reference designator. Add board assembly number for full designator.

4.5.18 A20 Board Adjustment (Figure 6-10)

a) Switch the 10 MHz decade to "1" position, pull A20 board half way out and adjust C24*, C36*, and C43* for maximum output on the Millivac. The output should be "0" dBm ±1 dB.

b) If the output is too high or low remove the cover and re-tune C24*, C36*, and C43* for maximum output.

c) If the output is too high, un-solder and move the tap on L6* down toward ground until the output is "0" dBm ±1 dB, re-peak C24* after soldering the tap back on the coil.

d) If the output is too low, un-solder and move the tap on L8* up until the output is "0" dBm ±1 dB, re-peak C43* after soldering the tap back on the coil.

NOTE

If the output cannot be obtained by moving the tap on L8*, un-solder and move the tap up on L7* or L6*. Do not move the tap up more than on half turn on L7* or L6*.

e) Disconnect the BNC on the "R" port of Z1* and connect it to the spectrum analyzer input.

f) Set the dispersion to 10 MHz with 700 MHz center frequency.

g) Peak C13 of A11 board (see figure 6-9) for maximum output with minimum sidebands on analyzer.

h) Tune C2, C5, C8, and C11 of A10 board (see figures 4-3 and 6-8) for maximum amplitude with minimum sidebands approximately 40 dB down or greater.

i) Disconnect the input to the analyzer and connect it to the Millivac. The output level should be between +4 dBm and +10 dBm.

j) While observing output level of the Millivac switch the 100 MHz decade up or down 1 position the output level should not change more than ±1 dB. Disconnect Millivac and connect spectrum analyzer as before.

k) Re-install the cover on board and re-peak C24*, C36*, and C43*. Push the board back into the compartment.

4.5.19 A19 Board Adjustment (Figure 6-10)

a) Switch the 100 MHz decade to number 1 position and the 10 MHz decade to number 2 position. Pull A19 board half way out and adjust C24*, C36*, and C43* for maximum output on the Millivac output of approximately "0" dBm ±1 dB at connector to "I" port of Z2 (Use 50 ohm termination on voltmeter).

b) Repeat steps 4.5.18b through 4.5.18d if required.

c) Set the center frequency of the spectrum analyzer to 800 MHz. Peak C21 of A11 (figure 6-9) for maximum output with minimum sidebands on the analyzer.

d) Tune C15, C18, C22, and C25 of A10 board (figures 4-3 and 6-8) for maximum amplitude with minimum sidebands approximately 40 dB down or greater.

e) Repeat steps 4.5.18i through 4.5.18k.

4.5.20 A18 Board Adjustment (Figure 6-10)

a) Switch the 100 MHz decade to number 2 position and the 10 MHz decade to number 3 position, pull A18 board half way out and adjust C24*, C36*, and C43* for maximum output on the Millivac of approximately "0" dBm ±1 dB at connector to "I" port of Z2 (use 50 ohm termination on voltmeter).

b) Repeat steps 4.5.18b through 4.5.18d if required.

c) Set the center frequency of the spectrum analyzer to 900 MHz peak C28 of A11 for maximum output with minimum sidebands on the analyzer.

d) Tune C28, C32, C36, and C39 of A10 board (figures 4-3 and 6-8) for maximum amplitude with minimum sidebands approximately 40 dB down or greater.

e) Repeat steps 4.5.18i through 4.5.18k.

*Partial reference designator. Add board assembly number for full designator.

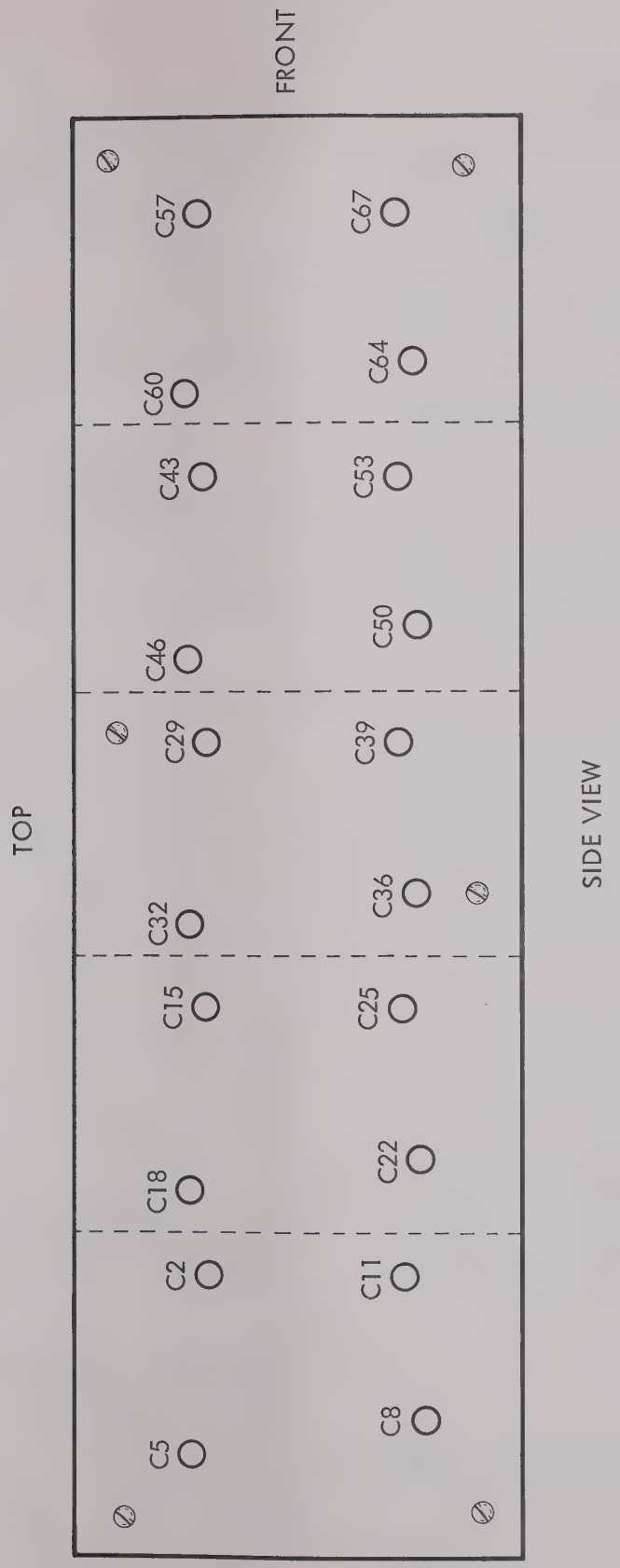


Figure 4-3. Access Hole Identifications, A10

4.5.21 A17 Board Adjustment

a) Switch the 100 MHz decade to number 3 position and the 10 MHz decade to number 4 position, pull A17 board half way out and adjust C24*, C36*, and C43* for maximum output on the Millivac of approximately "0" dBm ±1 dB at connector to "I" port of Z2 (use 50 ohm termination on voltmeter).

b) Repeat steps 4.5.18b through 4.5.18d if required.

c) Set the center frequency of the spectrum analyzer to 1 GHz. Peak C34 of A11 (figure 6-9) for maximum output with minimum sidebands on the analyzer.

d) Tune C43, C46, C50, and C53 of A10 board for maximum amplitude with minimum sidebands, approximately 40 dB down or greater.

e) Repeat steps 4.5.18i through 4.5.18k.

4.5.22 A16 Board Adjustment

a) Switch the 100 MHz decade to number 4 position and the 10 MHz decade to number 5 position. Pull A16 board half way out and adjust C24*, C36*, and C43* for maximum output on the Millivac of approximately "0" dBm ±1 dB at connector to "I" port of Z2 (use 50 ohm termination on voltmeter).

b) Repeat steps 4.5.18b through 4.5.18d.

c) Set the center frequency of the spectrum analyzer to 1.1 GHz peak C40 of A11 for maximum output with minimum sidebands on the analyzer.

d) Tune C57, C60, C64, and C67 of A10 board (figures 4-3 and 6-8) for maximum amplitude with minimum sidebands approximately 40 dB down or greater.

e) Repeat steps 4.5.18i through 4.5.18k.

f) Disconnect the input to the spectrum analyzer and re-connect the BNC to the "R" port of Z1*.

4.5.23 A15 Board Adjustment

a) Switch the 10 MHz decade to number 6 position, pull A15 board half way out and adjust C24*, C36*, and C43* for maximum output on the Millivac approximately "0" dBm ±1 dB at connector to "I" port of Z2 (use 50 ohm termination on voltmeter).

b) Repeat steps 4.5.18b through d and 4.5.18k.

4.5.24 A14 Board Adjustment

a) Switch the 10 MHz decade to number 7 position, pull A14 board half way out and adjust C24*, C36*, and C43* (figure 6-10) for maximum output on the Millivac approximately "0" dBm ±1 dB at connector to "I" port of Z2 (use 50 ohm termination on voltmeter).

b) Repeat steps 4.5.18b through d and 4.5.18k.

4.5.25 A13 Board Adjustment

a) Switch the 10 MHz decade to number 8 position, pull A13 board half way out and adjust C24*, C36*, and C43* for maximum output on the Millivac of approximately "0" dBm ±1 dB at connector to "I" port of Z2 (use 50 ohm termination on voltmeter).

b) Repeat steps 4.5.18b through 4.5.18k if required.

c) Disconnect the Millivac and re-connect the BNC to the "I" port of Z2.

4.5.26 A12 Board Adjustment

a) Switch the 10 MHz decade to number 9 position. Pull board A12 half way out and adjust C24*, C36*, and C43* for maximum output on the Millivac of approximately "0" dBm ±1 dB at connector to "I" port of Z2 (use 50 ohm termination on voltmeter).

b) Repeat steps 4.5.18b through 4.5.18k.

c) Disconnect Millivac and re-connect the BNC to the "I" port of Z2.

*Partial reference designator. Add board assembly number for full designator.

4.5.27 A8 Board Adjustment

a) Disconnect the BNC on the "R" port of Z2 and connect it to the Millivac, the output level should be approximately +3 dBm or greater. (Use 50 ohm termination on voltmeter.)

b) While observing the output on the Millivac, peak C13 of A11 board for maximum output.

c) Un-screw and lift out A8 assembly, peak C3*, C6*, C9*, and C12* for maximum output on the Millivac.

d) Switch the 100 KHz and 1 MHz decades to number 4 position and peak C21*, C18*, and C15* for maximum output on the Millivac.

e) Switch the 100 KHz and 1 MHz decades from 0 through 9, and output should not fall below +3 dBm.

f) Disconnect the Millivac and re-connect the BNC to the "R" port of Z2.

4.5.28 A7 Board Adjustment

a) Disconnect the BNC on the "L" port of Z1 and connect it to the Millivac.

b) Switch the 100 KHz and 1 MHz decades from 0 through 9, the output should not fall below −13 dBm.

c) Disconnect the Millivac and re-connect the BNC to the "L" port of Z1.

4.5.29 A1A2 Adjustment

a) Turn FM-10 off and pull left hand module half way out. Install patch cable PC2652 and turn unit on.

b) Disconnect the BNC on the input to the variable attenuator and connect the Millivac to the BNC mounted on the chassis.

c) Set the synthesizer frequency to 250 MHz adjust R31* for an output of -23 dBm on the Millivac.

d) Switch the 100, 10 and 1 MHz decades throughout their ranges, the output should not vary more than ±1 dB. Re-adjust R31* if necessary.

e) Disconnect the Millivac and re-connect the input to the variable attenuator. Remove patch cable and install left hand module.

4.6 Calibration of TCXO

4.6.1 Either of two methods may be used to calibrate the TCXO. One uses a frequency counter and the other uses the Lissajous figure technique in conjunction with an oscilloscope.

4.6.2 Calibration using counter.

4.6.3 Connect the FM-10 RF output jack to the input jack of the Kay amplifier. Connect the output jack of the Kay amplifier to the counter.

4.6.4 Rotate the hinged cover plate away from the access hole in left side panel of FM-10.

4.6.5 Remove protective cap screw directly behind the cover plate with holding driver. (Cap screw may be either slot-head or hex-head).

4.6.6 Observe small slot-head frequency adjustment trimmer behind the cap screw, and carefully turn to adjust frequency.

WARNING

Check that the protective cap screw is in position by reference to Figure 1. If it is accidentally missing, you may wrongly assume that the trimmer is the cap screw.

4.6.7 Set the FM-10 to 1 MHz and adjust the TCXO and board A11 for exactly 1 MHz

4.6.8 Calibration using Lissajous Figure.

4.6.9 Connect FM-10, 1 MHz frequency standard into a Lissajous figure test set-up. Set the FM-10 for 1 MHz operation. For 1×10^{-7} accuracy, adjust TCXO Crystal so that Lissajous pattern executes two reversals in 10 seconds.

*Partial reference designator. Add board assembly number for full designator.

4.7 CALIBRATION OF 0-1 KHz CONTROL

a) Connect the FM-10 RF output jack to the input jack of the Kay amplifier. Connect the output jack of the Kay amplifier to the counter.

b) Check the "OUT" position of the 0-1 KHz control to see that it agrees with the mark on the panel. Pull A2 board up, set the 0-1 KHz dial to "0" and set the FM-10 frequency to 1 MHz. Turn the RF output control for a level sufficient to drive the counter.

c) Adjust A2L5 (figure 6-3) until the counter reads exactly 1 MHz.

d) Turn the 0-1 KHz control to 10 and adjust A2R31 for reading of 1.001 MHz on counter.

e) Turn the 0-1 KHz control to 5 and adjust A2R30 for reading of 1.0005 MHz on counter.

f) Repeat steps 4.7c, d, and e until the frequencies at the 0, 5, and 10 positions of the 0-1 KHz control are correct without re-adjustment.

g) Turn the 0-1 KHz from 1 to 9. The frequency should be within ±50 cps over this range.

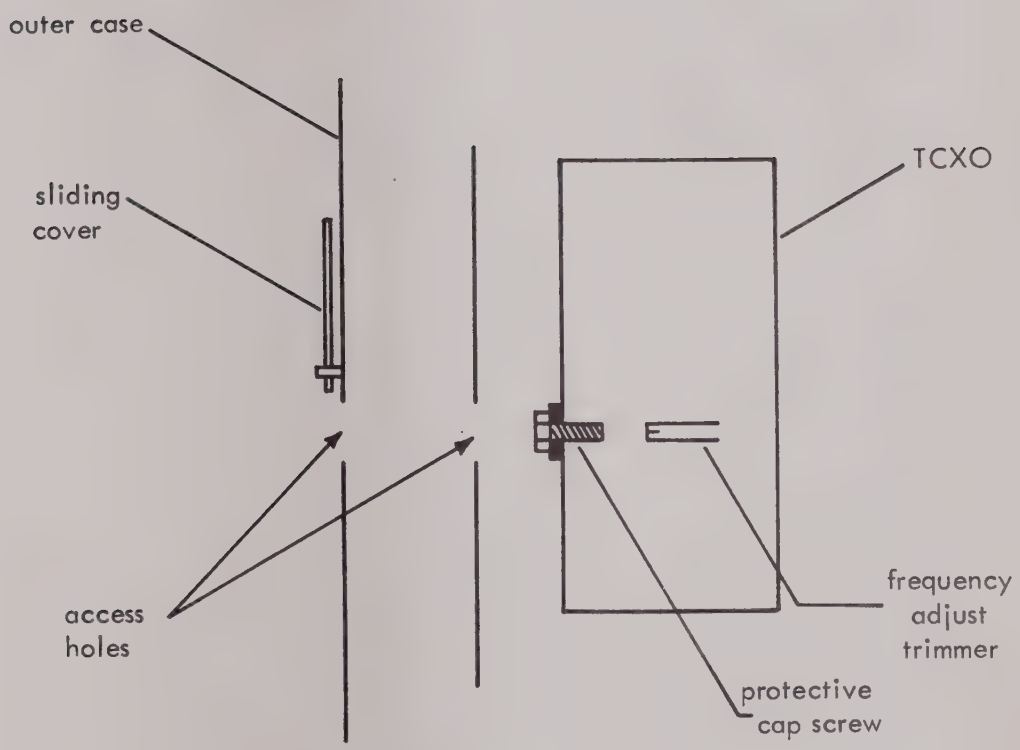


Figure 4-4. Access to TCXO

SECTION V
SCHEMATICS

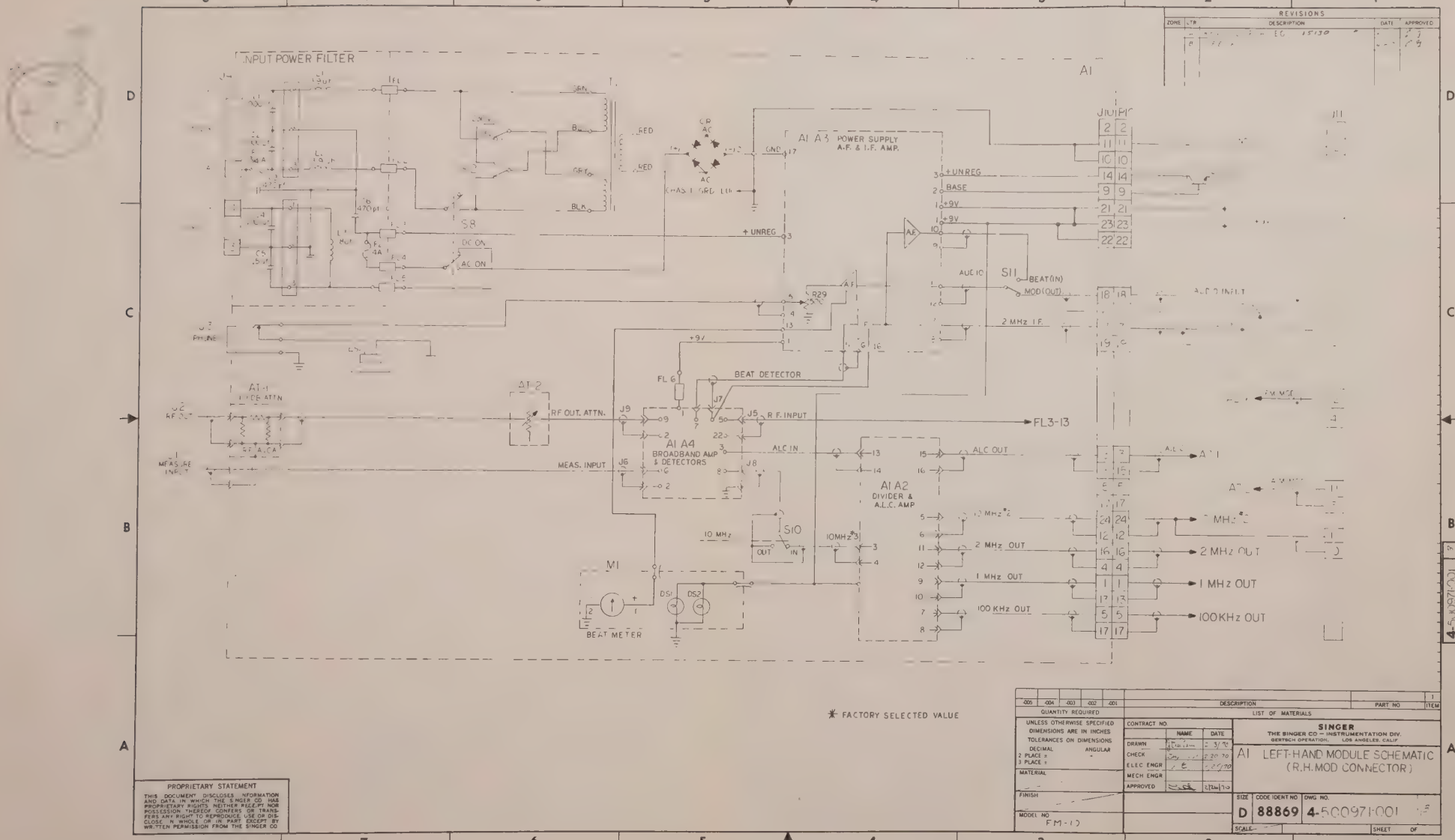
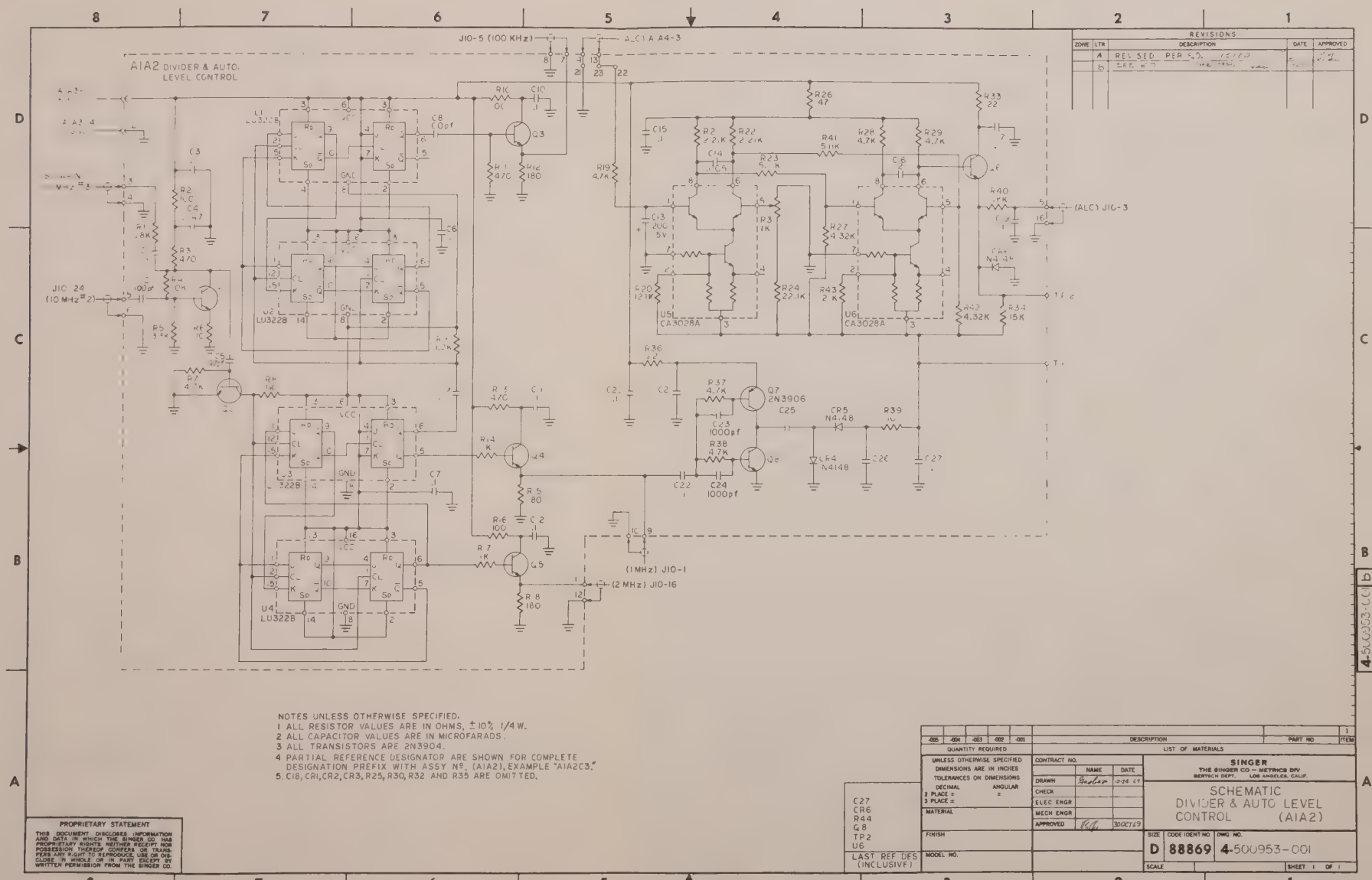


Figure 5-1. Left Handle Module Schematic Diagram (A1)


A1A2 DIVIDER & AUTO. LEVEL CONTROL
J10-5 (100 KHz)
A(C) A A4-3
(ALC) J10-3
J10-24 (10 MHz ÷2)
(1MHz) J10-1
(2 MHz) J10-16
U1 LU322B
U2 LU322B
U4 LU322B
U5 CA3028A
U6 CA3028A
NOTES UNLESS OTHERWISE SPECIFIED.
1 ALL RESISTOR VALUES ARE IN OHMS, ±10% 1/4 W.
2 ALL CAPACITOR VALUES ARE IN MICROFARADS.
3 ALL TRANSISTORS ARE 2N3904.
4 PARTIAL REFERENCE DESIGNATOR ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH ASSY Nº. (A1A2), EXAMPLE "A1A2C3."
5. C18, CR1, CR2, CR3, R25, R30, R32 AND R35 ARE OMITTED.
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C27 CR6 R44 Q8 TP2 U6
LAST REF DES (INCLUSIVE)
LIST OF MATERIALS
SINGER
THE SINGER CO — METRICS DIV.
SCHEMATIC DIVIDER & AUTO LEVEL CONTROL (A1A2)
SIZE D
CODE IDENT NO 88869
DWG NO. 4-500953-001
SCALE
SHEET 1 OF 1
4-500953-001 b

Figure 5-2. Divider and Automatic Level Control Schematic Diagram (A1A2)

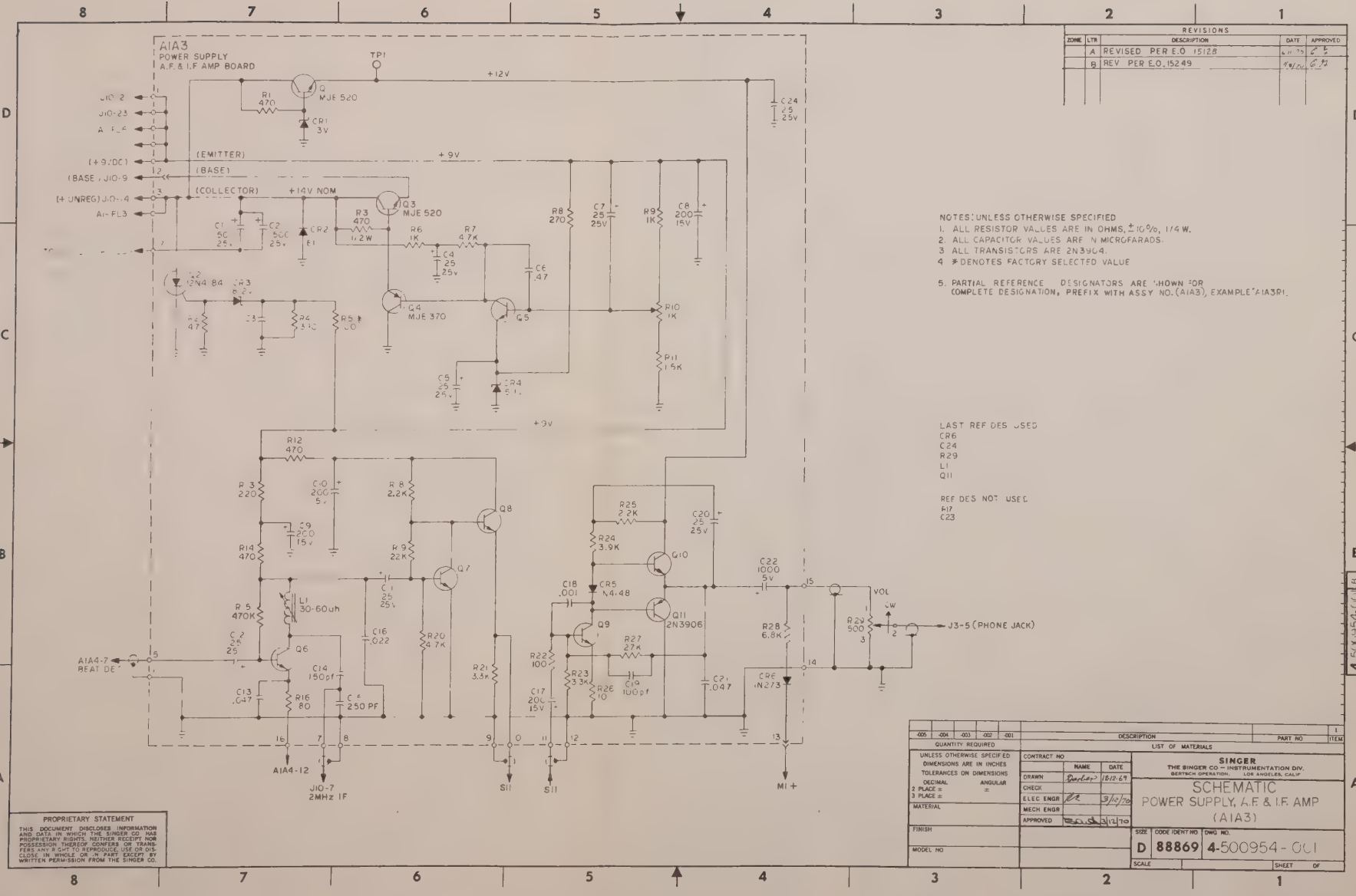

Figure 5-3. Power Supply, AF and IF Amplifier Schematic Diagram (A1A3)

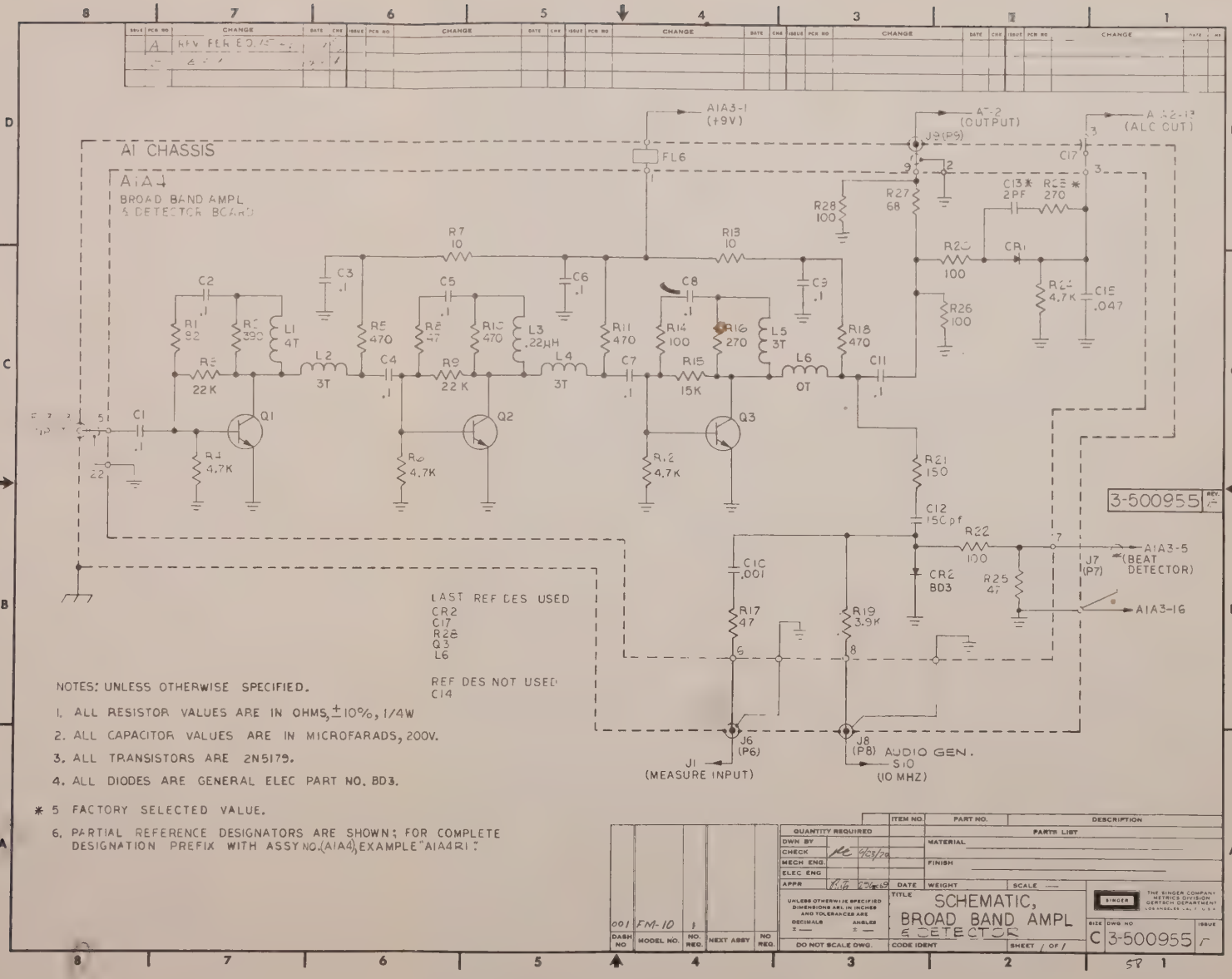

Figure 5-4. Broad Band Amplifier and Detector Schematic Diagram (A1A4)

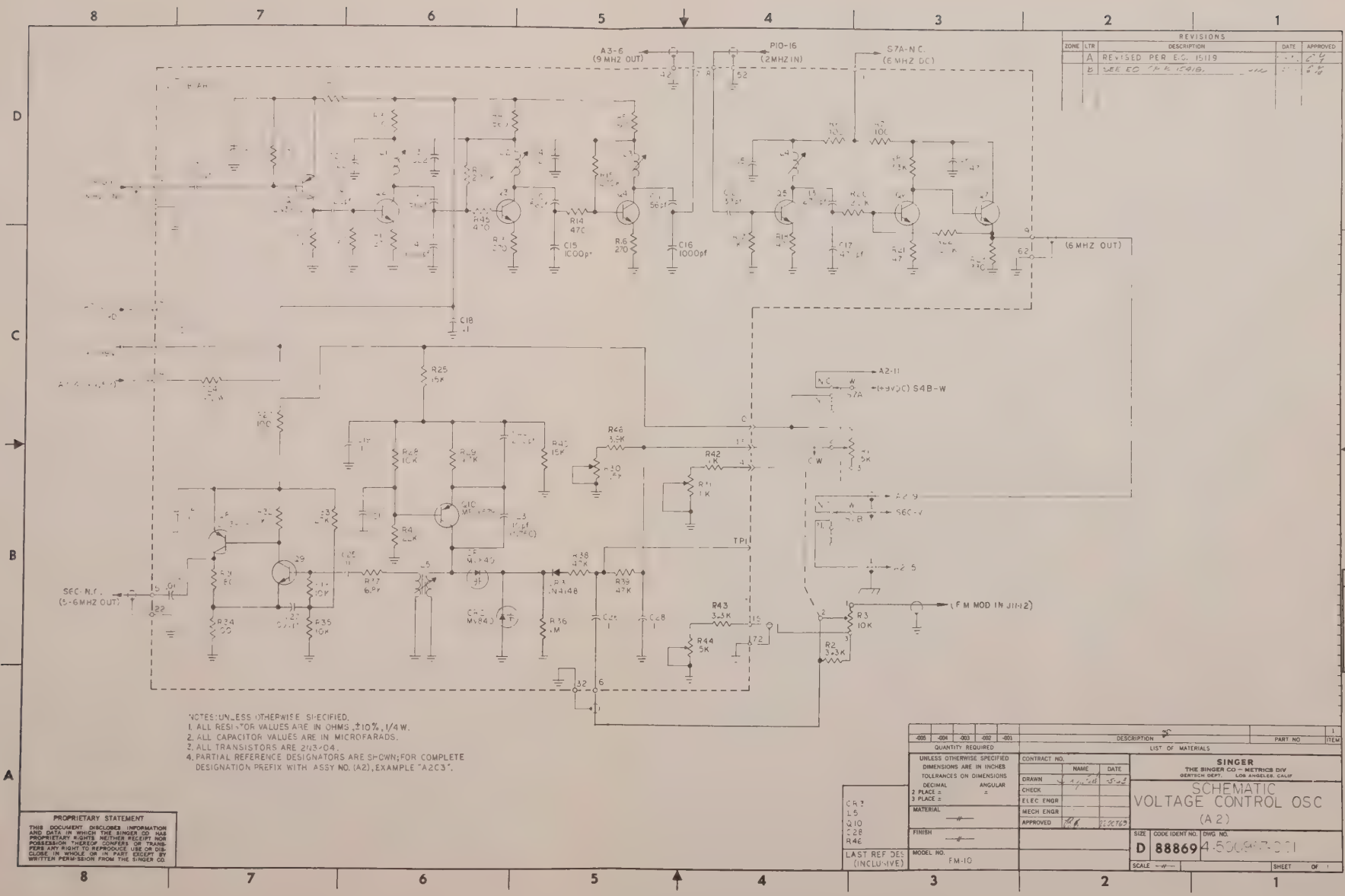

Figure 5-5. VCO, 6 and 9MHz General Schematic Diagram (A2)

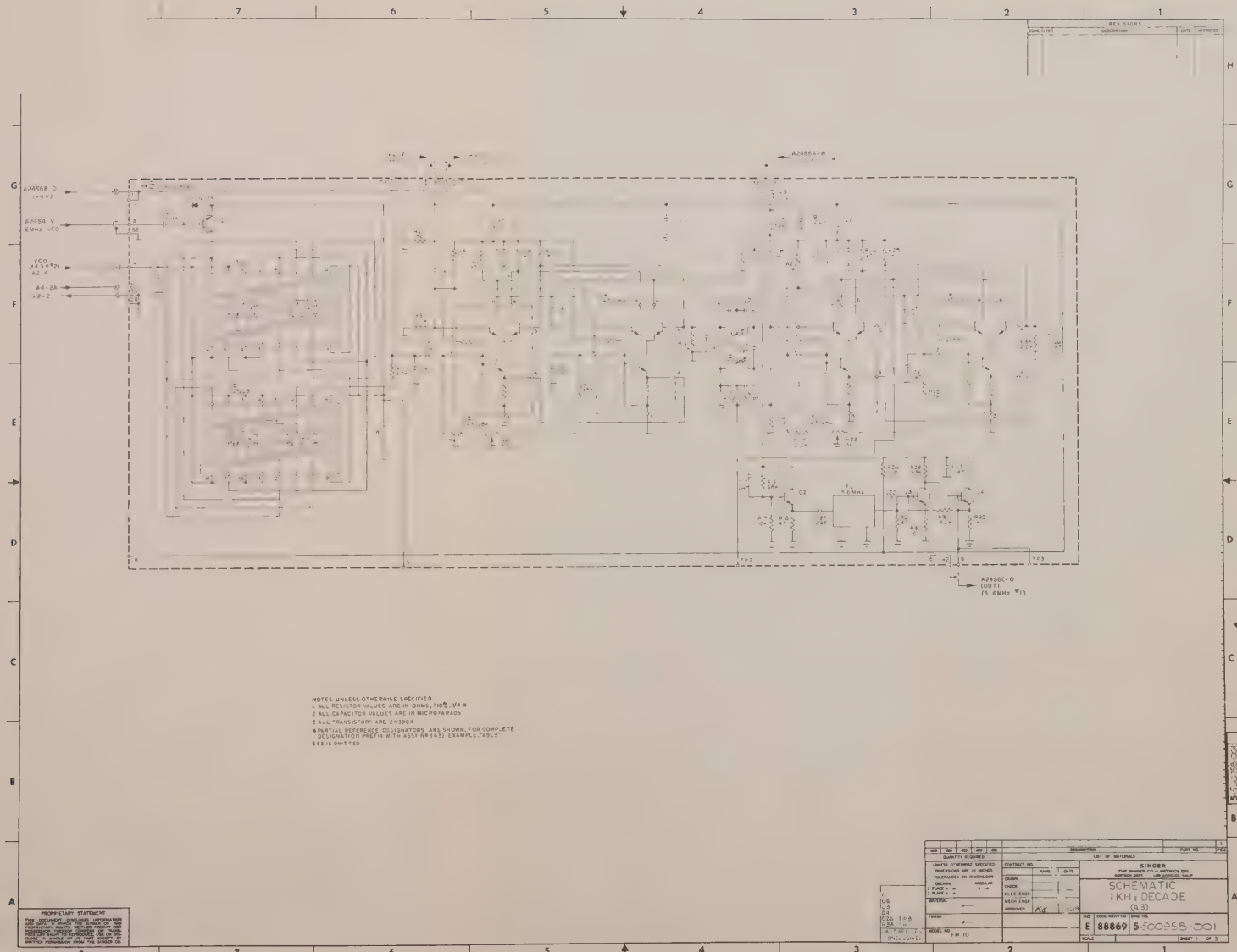

Figure 5-6. 1KHz Decade (A3) Schematic Diagram

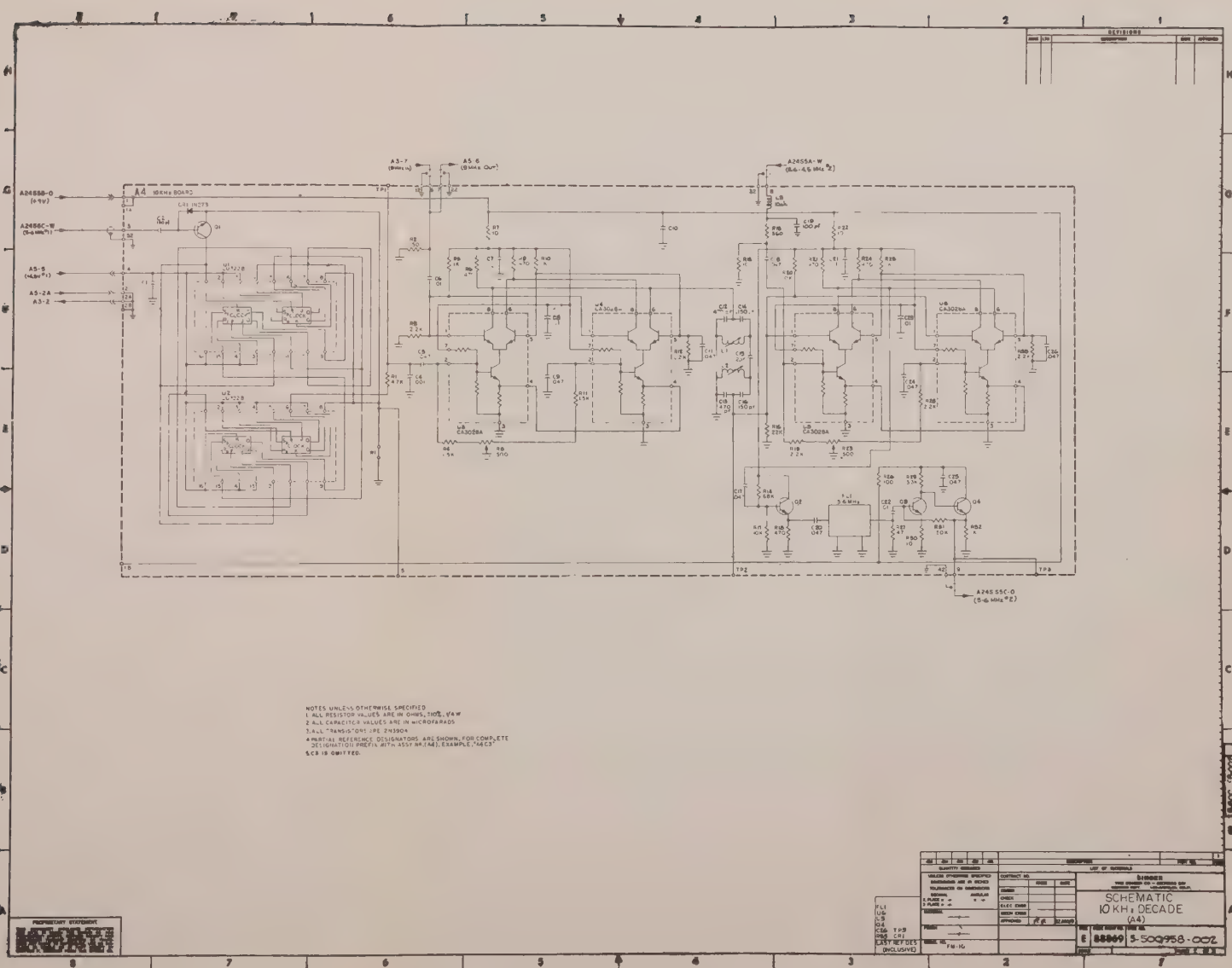

Figure 5-7. 10KHz Decade (A4), Schematic Diagram

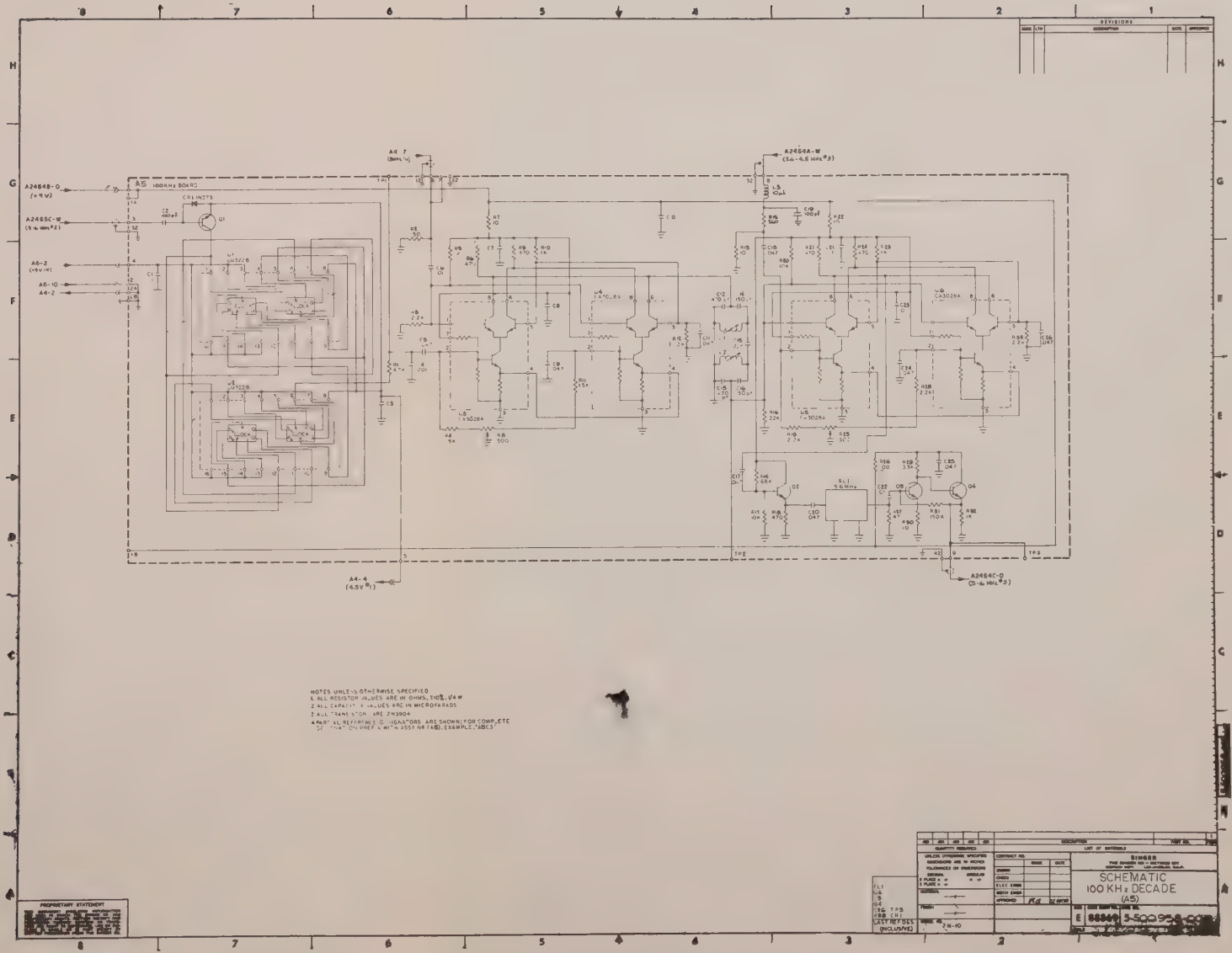

Figure 5-8. 100KHz Decade (A5), Schematic Diagram

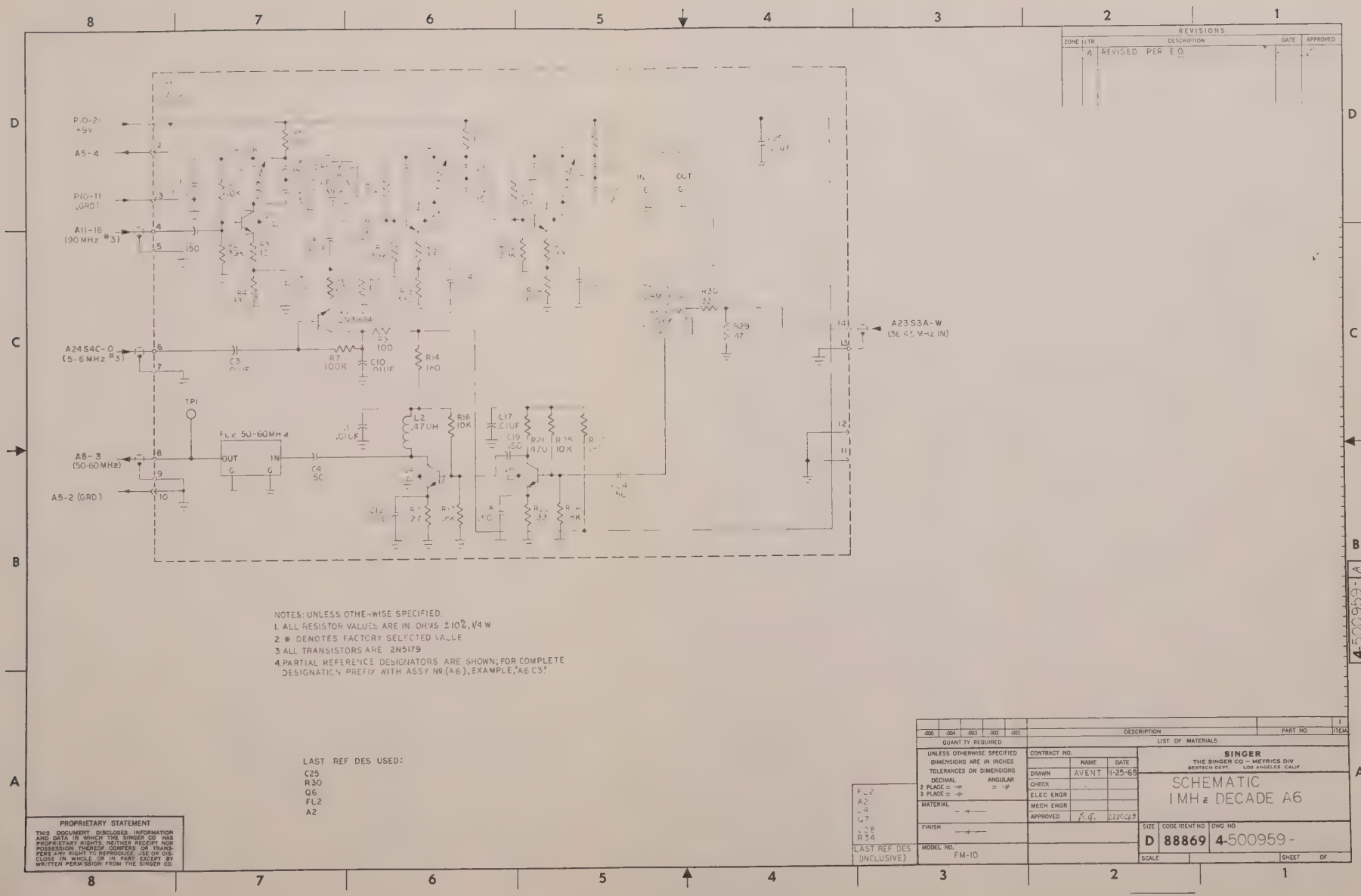
REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
A | REVISED PER E.O.
P.O-2 +9V
A5-4
P10-11 (GRD)
A11-18 (90MHz #3)
A24S4C-0 (5-6MHz #3)
A8-3 (50-60MHz)
A5-2 (GRD)
TP1
FL2 50-60MHz
OUT
IN
A23S3A-W (36.45 MHz IN)
NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4 W
2. * DENOTES FACTORY SELECTED VALUE
3. ALL TRANSISTORS ARE 2N5179
4. PARTIAL REFERENCE DESIGNATORS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO.(A6), EXAMPLE, "A6 C3"
LAST REF DES USED:
C25
R30
Q6
FL2
A2
LIST OF MATERIALS
SINGER
THE SINGER CO — METRICS DIV
SCHEMATIC
1MHz DECADE A6
SIZE D
CODE IDENT NO 88869
DWG NO 4-500959-
MODEL NO. FM-10
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Figure 5-9. 1MHz Decade (A6) Schematic Diagram

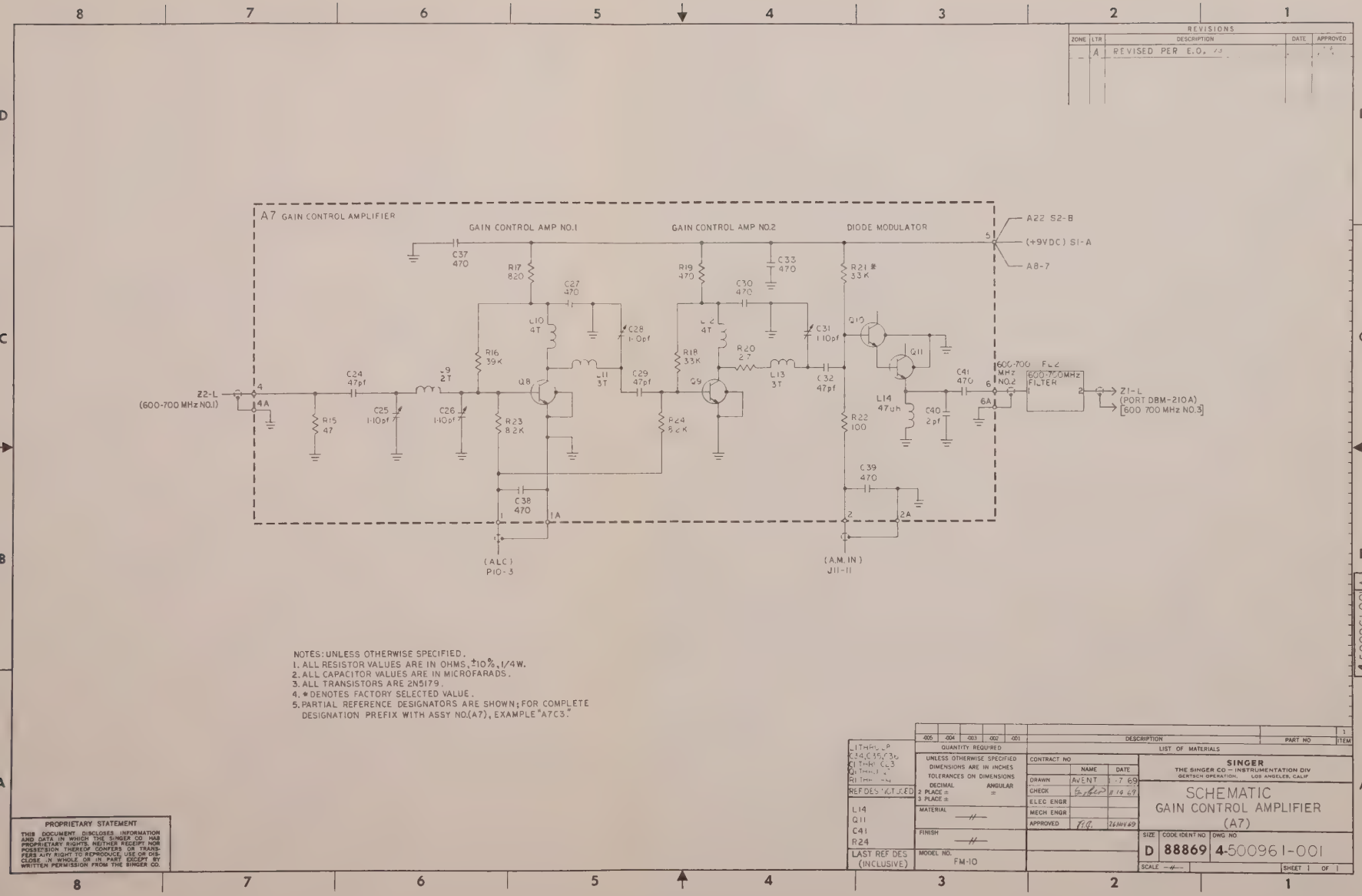
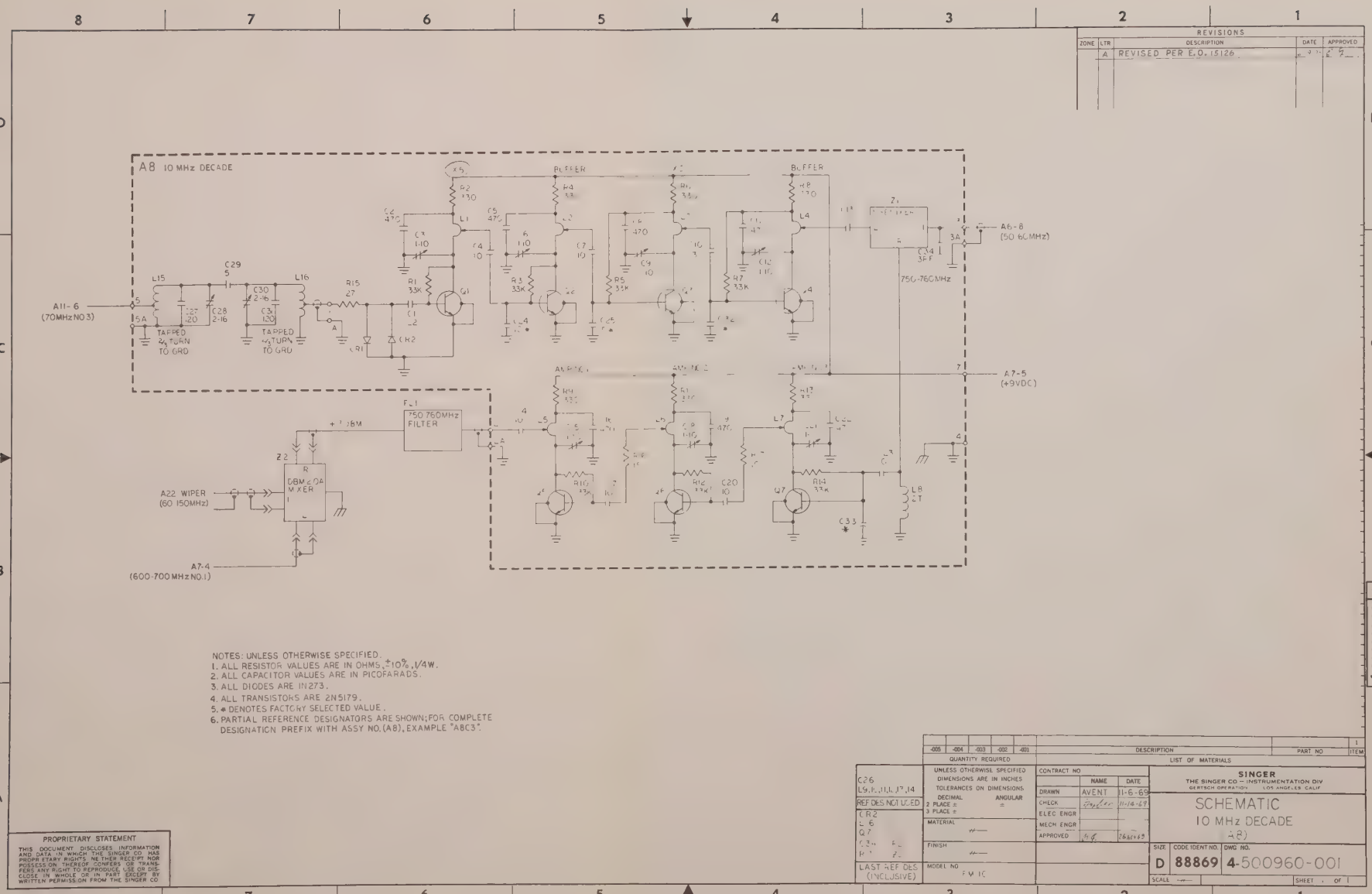


Figure 5-10. Gain Control Amp, Schematic Diagram (A7)


A8 10 MHz DECADE
BUFFER
BUFFER
A11-6 (70MHz NO 3)
TAPPED 1/2 TURN TO GRD
TAPPED 1/2 TURN TO GRD
750-760MHz
A6-8 (50 60MHz)
A7-5 (+9VDC)
750 760MHz FILTER
DBM 10A MIXER
A22 WIPER (60 150MHz)
A7-4 (600-700 MHz NO.1)
NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. ALL DIODES ARE IN273.
4. ALL TRANSISTORS ARE 2N5179.
5. * DENOTES FACTORY SELECTED VALUE.
6. PARTIAL REFERENCE DESIGNATORS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO. (A8), EXAMPLE "A8C3".
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ZONE LTR DESCRIPTION DATE APPROVED
A REVISED PER E.O. 15126
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LIST OF MATERIALS
DESCRIPTION PART NO ITEM
QUANTITY REQUIRED -005 -004 -003 -002 -001
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL ANGULAR 2 PLACE ± 3 PLACE ±
MATERIAL
FINISH
MODEL NO FM 1C
C26 L9,10,11,17,14
REF DES NOT USED
CR2 L6 Q7 C34 P1 P2
LAST REF DES (INCLUSIVE)
CONTRACT NO
NAME DATE
DRAWN AVENT 11-6-69
CHECK 11-10-69
ELEC ENGR
MECH ENGR
APPROVED
SINGER
THE SINGER CO — INSTRUMENTATION DIV
GERTSCH OPERATION LOS ANGELES CALIF
SCHEMATIC
10 MHz DECADE
(A8)
SIZE CODE IDENT NO. DWG NO.
D 88869 4-500960-001
SCALE SHEET OF
4-500960-001 A

Figure 5-11. 10MHz Decade Schematic Diagram (A8)

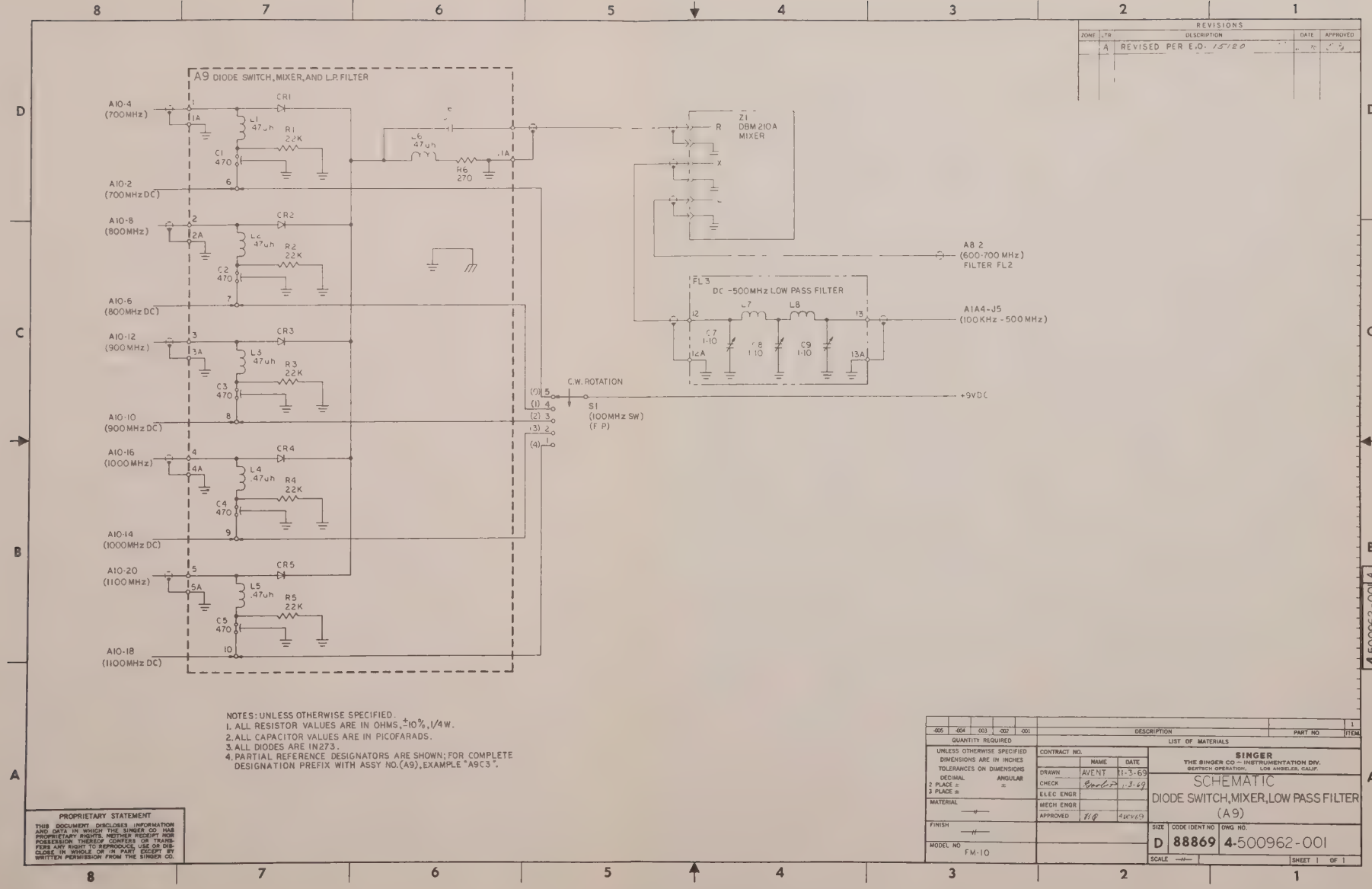
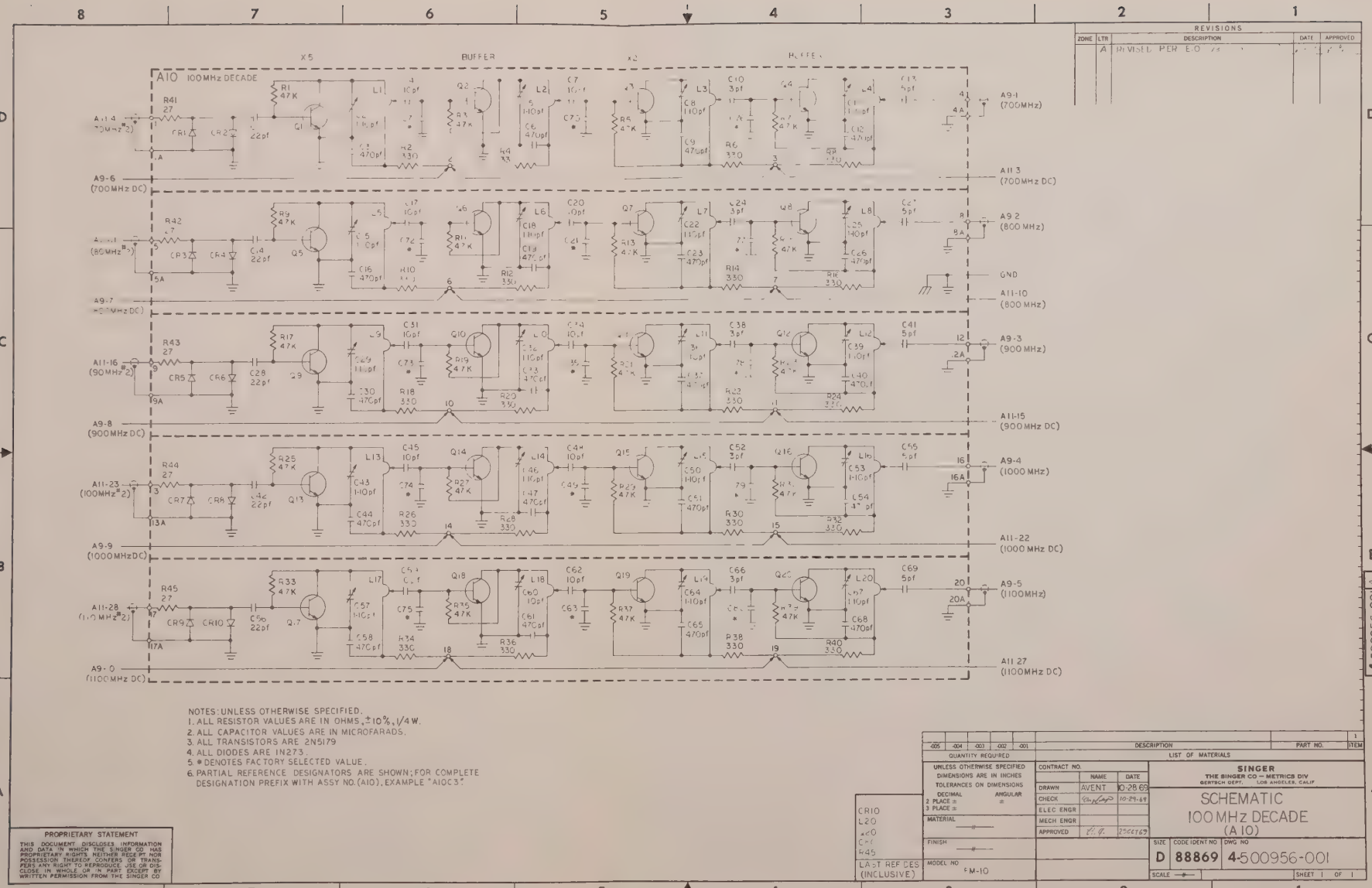


Figure 5-12. Diode Switch Schematic Diagram (A9)



NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. ALL TRANSISTORS ARE 2N5179
4. ALL DIODES ARE IN273.
5. * DENOTES FACTORY SELECTED VALUE.
6. PARTIAL REFERENCE DESIGNATORS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO. (A10), EXAMPLE "A10C3".

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED PER E.O. [illegible]		

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL 2 PLACE ± 3 PLACE ± ANGULAR ±	CONTRACT NO.		
		NAME	DATE
	DRAWN	AVENT	10-28-69
	CHECK	[illegible]	10-29-69
	ELEC ENGR		
MATERIAL	MECH ENGR		
FINISH	APPROVED	[illegible]	[illegible]
MODEL NO M-10			

SINGER
THE SINGER CO — METRICS DIV
GERTSCH DEPT. LOS ANGELES, CALIF

SCHEMATIC
100 MHz DECADE
(A10)

SIZE	CODE IDENT NO	DWG NO
D	88869	4-500956-001

SCALE — SHEET 1 OF 1

CR10
L20
[illegible]
C67
R45
LAST REF DES (INCLUSIVE)

4-500956-001 A

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Figure 5-13. 100MHz General Schematic Diagram (A10)

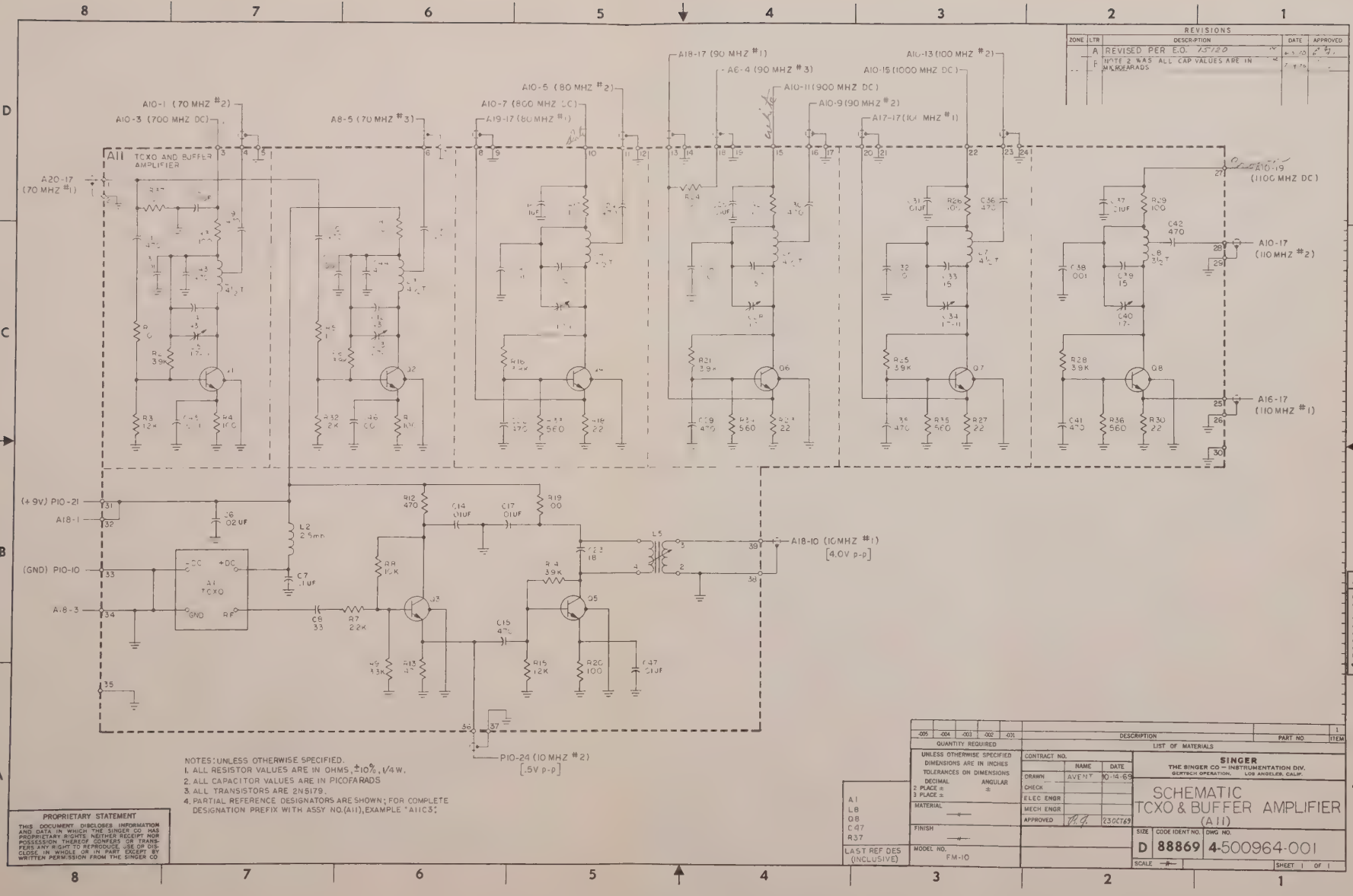
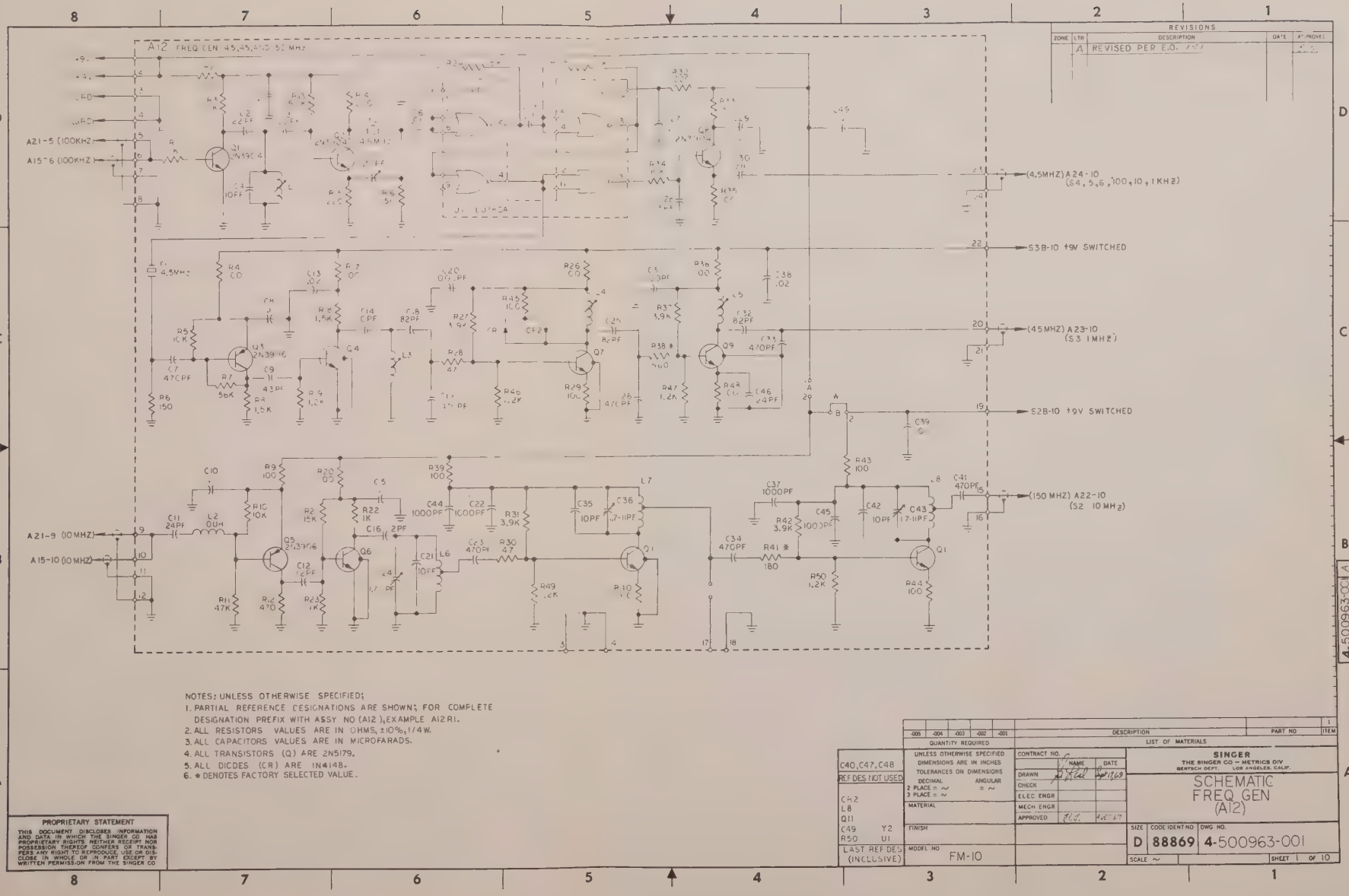


Figure 5-14. TCXO and Buffer Amplifier, General Schematic Diagram (A11)


A12 FREQ GEN 45,45,AND 150 MHz
A21-5 (100KHZ)
A15-6 (100KHZ)
A21-9 (10MHZ)
A15-10 (10MHZ)
(4.5MHZ) A24-10 (S4, 5, 6, 100, 10, 1 KHZ)
S3B-10 +9V SWITCHED
(45MHZ) A23-10 (S3 1MHZ)
S2B-10 +9V SWITCHED
(150 MHZ) A22-10 (S2 10 MHZ)
REVISIONS
ZONE LTR DESCRIPTION DATE APPROVED
A REVISED PER E.O.
NOTES: UNLESS OTHERWISE SPECIFIED;
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO (A12), EXAMPLE A12R1.
2. ALL RESISTORS VALUES ARE IN OHMS, ±10%, 1/4W.
3. ALL CAPACITORS VALUES ARE IN MICROFARADS.
4. ALL TRANSISTORS (Q) ARE 2N5179.
5. ALL DICDES (CR) ARE 1N4148.
6. * DENOTES FACTORY SELECTED VALUE.
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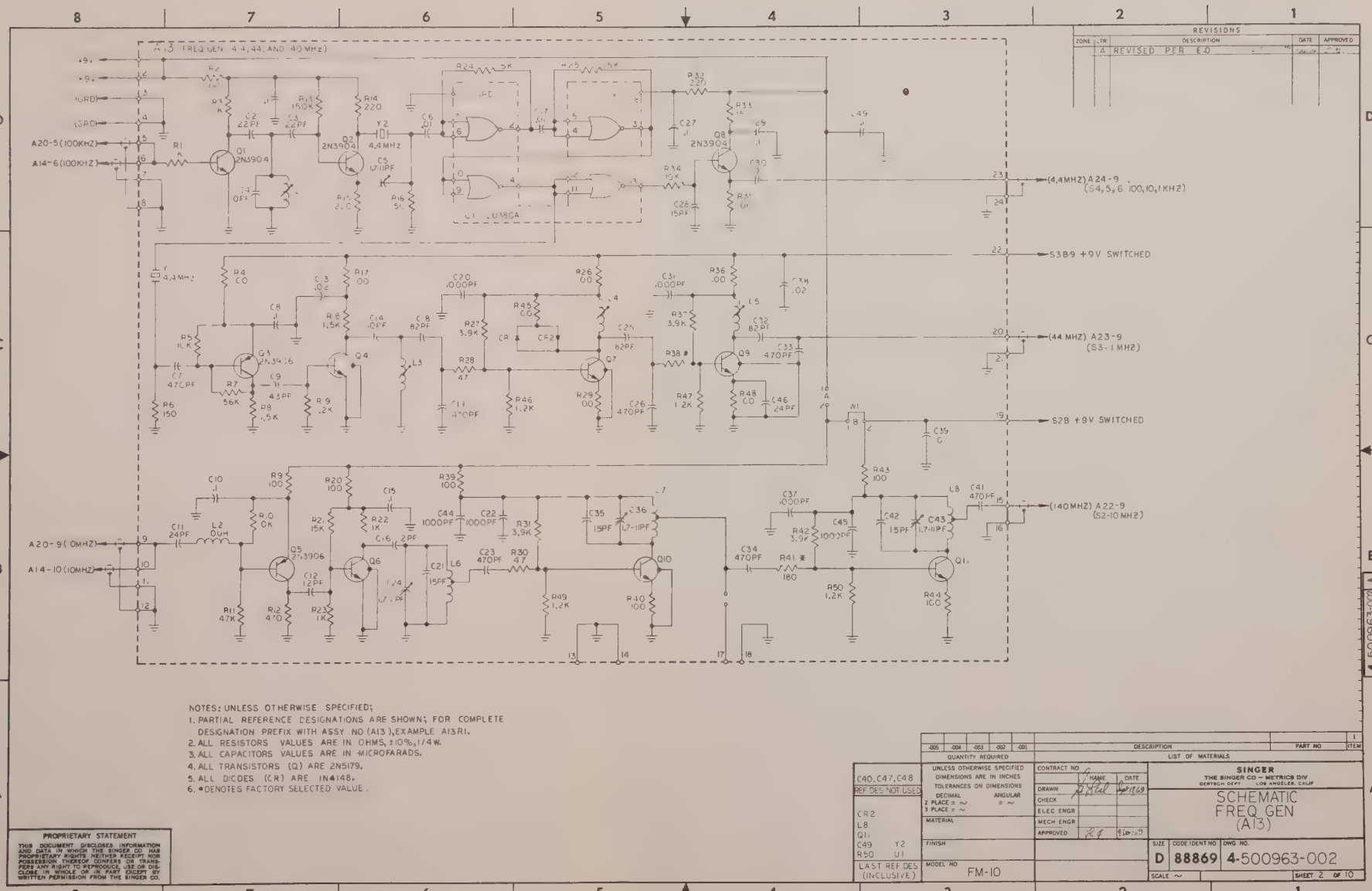
C40, C47, C48 REF DES NOT USED
CR2 L8 Q11 C49 Y2 R50 U1
LAST REF DES (INCLUSIVE)
QUANTITY REQUIRED
DESCRIPTION
PART NO
ITEM
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL 2 PLACE ± ~ 3 PLACE ± ~ ANGULAR ± ~
MATERIAL
FINISH
MODEL NO FM-10
CONTRACT NO.
NAME DATE
DRAWN
CHECK
ELEC ENGR
MECH ENGR
APPROVED
SINGER
THE SINGER CO — METRICS DIV
BENTSCH DEPT. LOS ANGELES, CALIF.
SCHEMATIC FREQ GEN (A12)
SIZE D
CODE IDENT NO 88869
DWG NO. 4-500963-001
SCALE ~
SHEET 1 OF 10
4-500963-001 A

Figure 5-15. 4.5, 45 and 150MHz General Schematic Diagram (A12)



NOTES: UNLESS OTHERWISE SPECIFIED;
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO (A13), EXAMPLE A13R1.
2. ALL RESISTORS VALUES ARE IN OHMS, ±10%, 1/4W.
3. ALL CAPACITORS VALUES ARE IN MICROFARADS.
4. ALL TRANSISTORS (Q) ARE 2N5179.
5. ALL DIODES (CR) ARE IN4148.
6. *DENOTES FACTORY SELECTED VALUE.

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED PER E.O.		

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LIST OF MATERIALS

-005	-004	-003	-002	-001	DESCRIPTION	PART NO	ITEM
QUANTITY REQUIRED							

C40, C47, C48 REF DES NOT USED

CR2
L8
Q11
C49 Y2
R50 U1

LAST REF DES (INCLUSIVE)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL: 2 PLACE ± ~, 3 PLACE ± ~
ANGULAR: ± ~

MATERIAL

FINISH

MODEL NO: FM-10

	NAME	DATE
CONTRACT NO		
DRAWN	[illegible]	9/17/69
CHECK		
ELEC ENGR		
MECH ENGR		
APPROVED	[illegible]	9/26/69

SINGER
THE SINGER CO — METRICS DIV
GERTSCH DEPT LOS ANGELES, CALIF

SCHEMATIC
FREQ GEN
(A13)

SIZE	CODE IDENT NO	DWG NO.
D	88869	4-500963-002

SCALE ~ SHEET 2 OF 10

4-500963-002 A

Figure 5-16. 4.4, 44 and 140MHz General Schematic Diagram (A13)

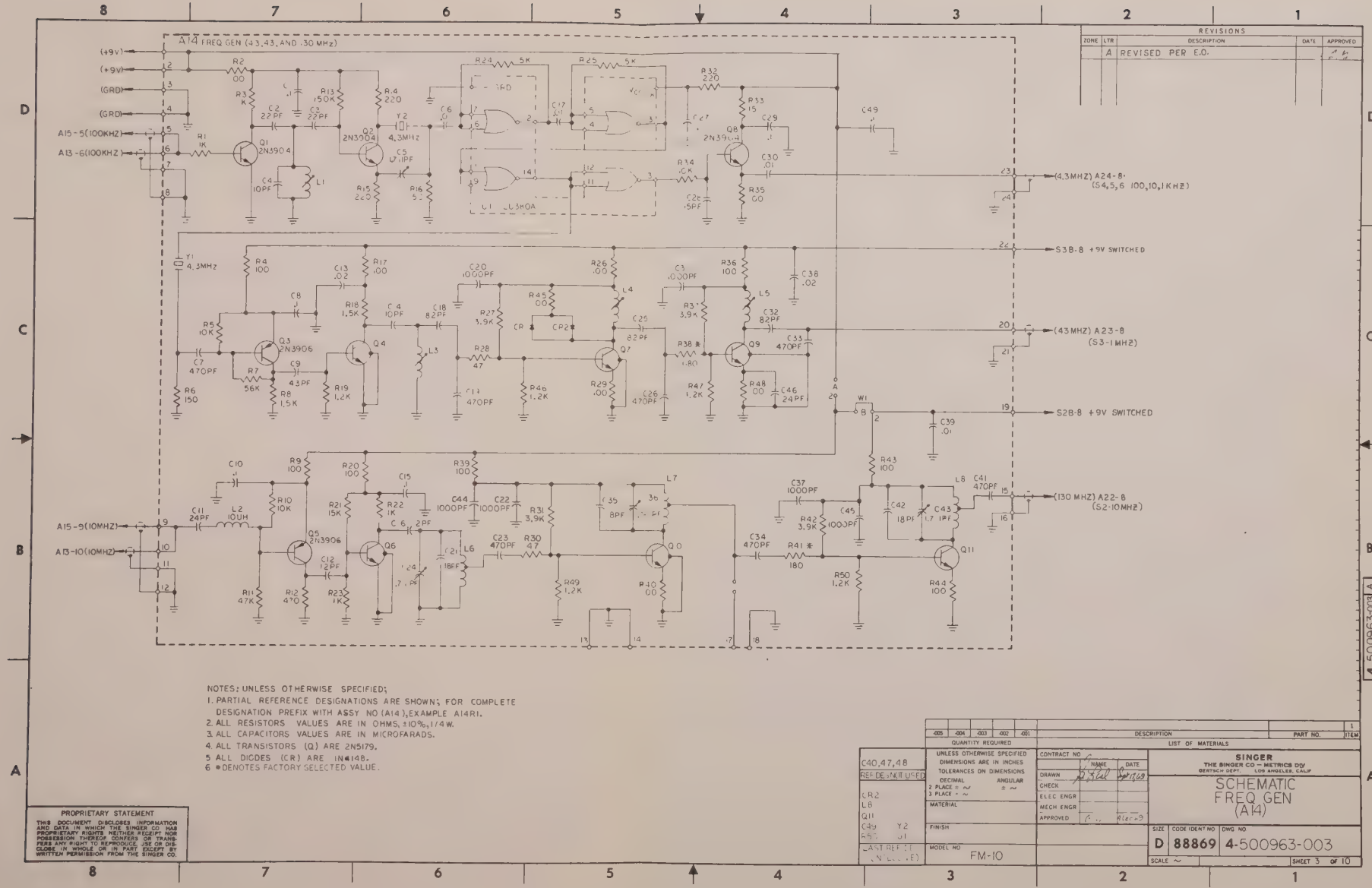
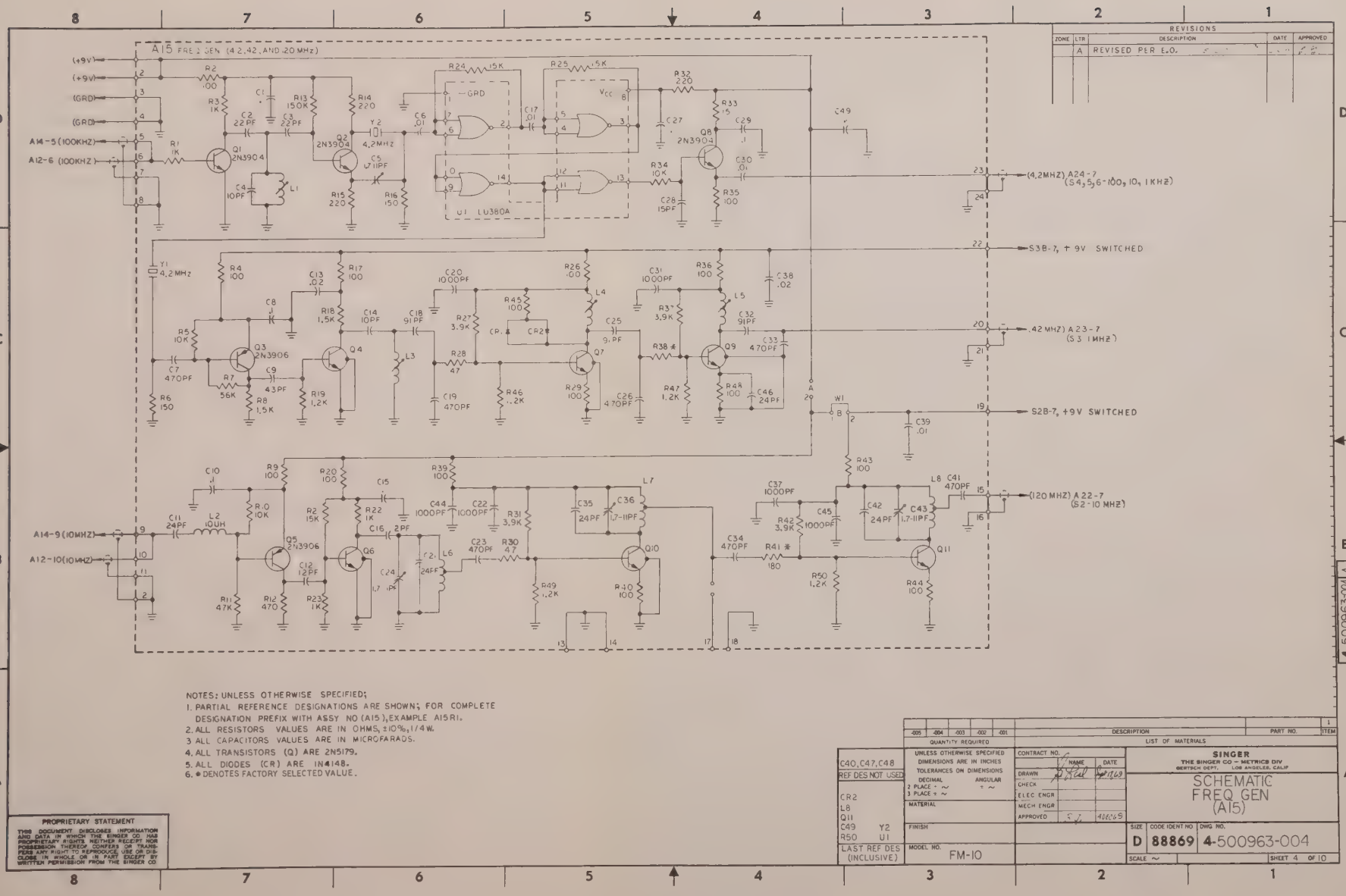


Figure 5-17. 4.3, 43 and 130MHz General Schematic Diagram (A14)


A15 FREQ GEN (42,42, AND 120 MHz)
U1 LU380A
(+9V)
(GRD)
A14-5 (100KHZ)
A12-6 (100KHZ)
A14-9 (10MHZ)
A12-10 (10MHZ)
(4.2MHZ) A24-7 (S4,5,6-100, 10, 1KHZ)
S3B-7, +9V SWITCHED
42 MHZ) A23-7 (S3 1MHZ)
S2B-7, +9V SWITCHED
(120 MHZ) A22-7 (S2-10 MHZ)
REVISIONS
ZONE LTR DESCRIPTION DATE APPROVED
A REVISED PER E.O.
NOTES: UNLESS OTHERWISE SPECIFIED;
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO (A15), EXAMPLE A15R1.
2. ALL RESISTORS VALUES ARE IN OHMS, ±10%, 1/4W.
3. ALL CAPACITORS VALUES ARE IN MICROFARADS.
4. ALL TRANSISTORS (Q) ARE 2N5179.
5. ALL DIODES (CR) ARE IN4148.
6. * DENOTES FACTORY SELECTED VALUE.
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-005 -004 -003 -002 -001 QUANTITY REQUIRED
DESCRIPTION PART NO. ITEM
LIST OF MATERIALS
C40, C47, C48 REF DES NOT USED
CR2 L8 Q11 C49 Y2 R50 U1 LAST REF DES (INCLUSIVE)
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL ANGULAR 2 PLACE ± ~ 3 PLACE ± ~
MATERIAL
FINISH
MODEL NO. FM-10
CONTRACT NO.
NAME DATE
DRAWN
CHECK
ELEC ENGR
MECH ENGR
APPROVED
SINGER THE SINGER CO — METRICS DIV GERTSCH DEPT. LOS ANGELES, CALIF
SCHEMATIC FREQ GEN (A15)
SIZE D CODE IDENT NO 88869 DWG NO. 4-500963-004
SCALE ~ SHEET 4 OF 10
4-500963-004 A

Figure 5-18. 4.2, 42 and 120MHz General Schematic Diagram (A15)

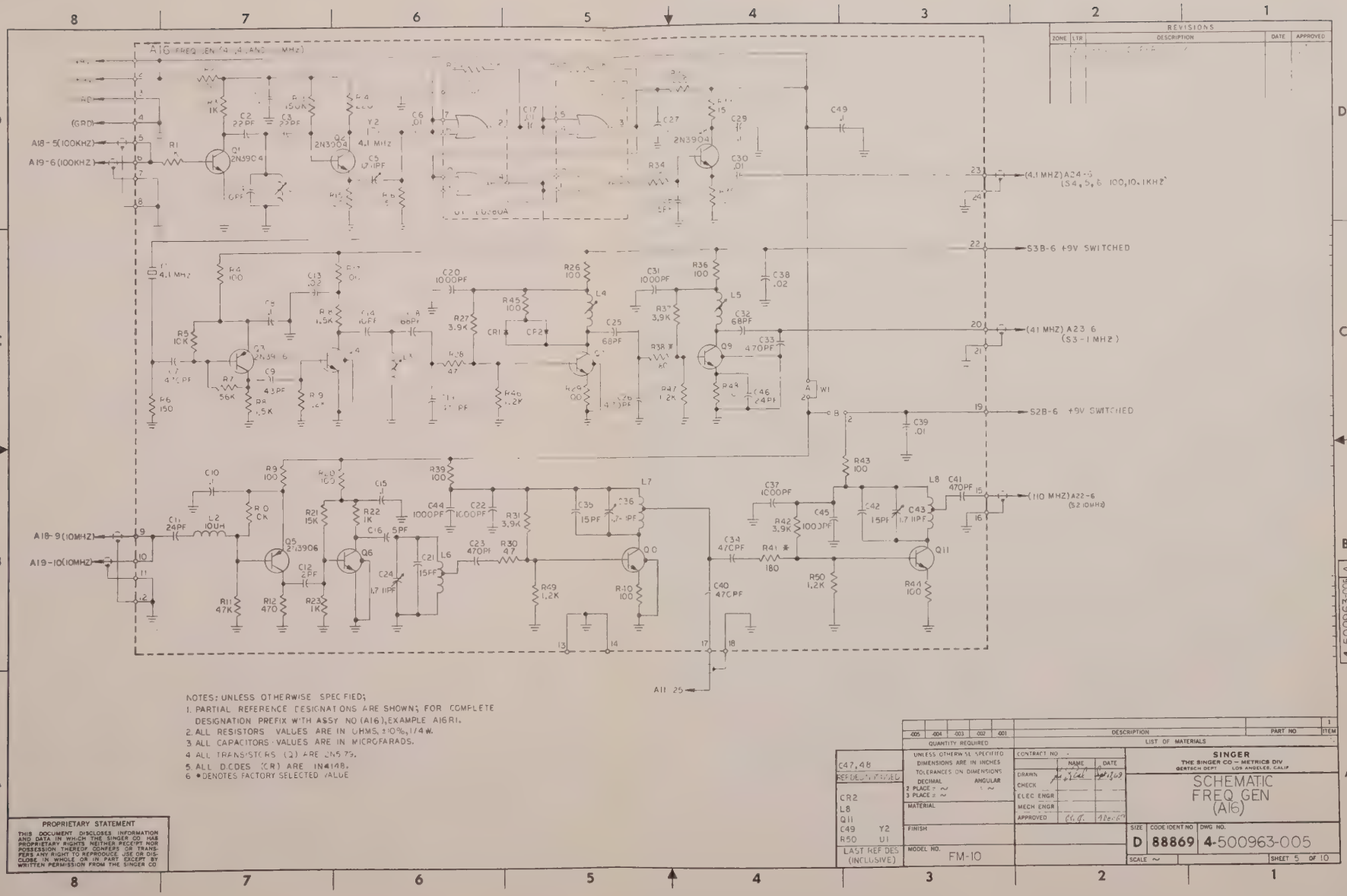
A16 FREQ GEN (4.1 AND 41 MHZ)
A18-5(100KHZ)
A19-6(100KHZ)
(GRD)
Y2 4.1 MHZ
(4.1 MHZ) A24-5 (S4, 5, 6 100, 10, 1KHZ)
S3B-6 +9V SWITCHED
(41 MHZ) A23 6 (S3-1 MHZ)
S2B-6 +9V SWITCHED
(110 MHZ) A22-6 (S2 10MHZ)
A18-9(10MHZ)
A19-10(10MHZ)
A11 25
NOTES: UNLESS OTHERWISE SPECIFIED;
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO (A16), EXAMPLE A16R1.
2. ALL RESISTORS VALUES ARE IN OHMS, ±10%, 1/4 W.
3. ALL CAPACITORS VALUES ARE IN MICROFARADS.
4. ALL TRANSISTORS (Q) ARE 2N579.
5. ALL DIODES (CR) ARE IN4148.
6. * DENOTES FACTORY SELECTED VALUE
REVISIONS
ZONE LTR DESCRIPTION DATE APPROVED
LIST OF MATERIALS
QUANTITY REQUIRED
DESCRIPTION
PART NO
ITEM
C47, 48
CR2
L8
Q11
C49 Y2
R50 U1
LAST REF DES (INCLUSIVE)
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL 2 PLACE ± 3 PLACE ± ANGULAR ±
MATERIAL
FINISH
MODEL NO. FM-10
CONTRACT NO
DRAWN
CHECK
ELEC ENGR
MECH ENGR
APPROVED
SINGER
THE SINGER CO — METRICS DIV
GERTSCH DEPT LOS ANGELES, CALIF.
SCHEMATIC FREQ GEN (A16)
SIZE D
CODE IDENT NO 88869
DWG NO. 4-500963-005
SCALE ~
SHEET 5 OF 10
4-500963-005 A
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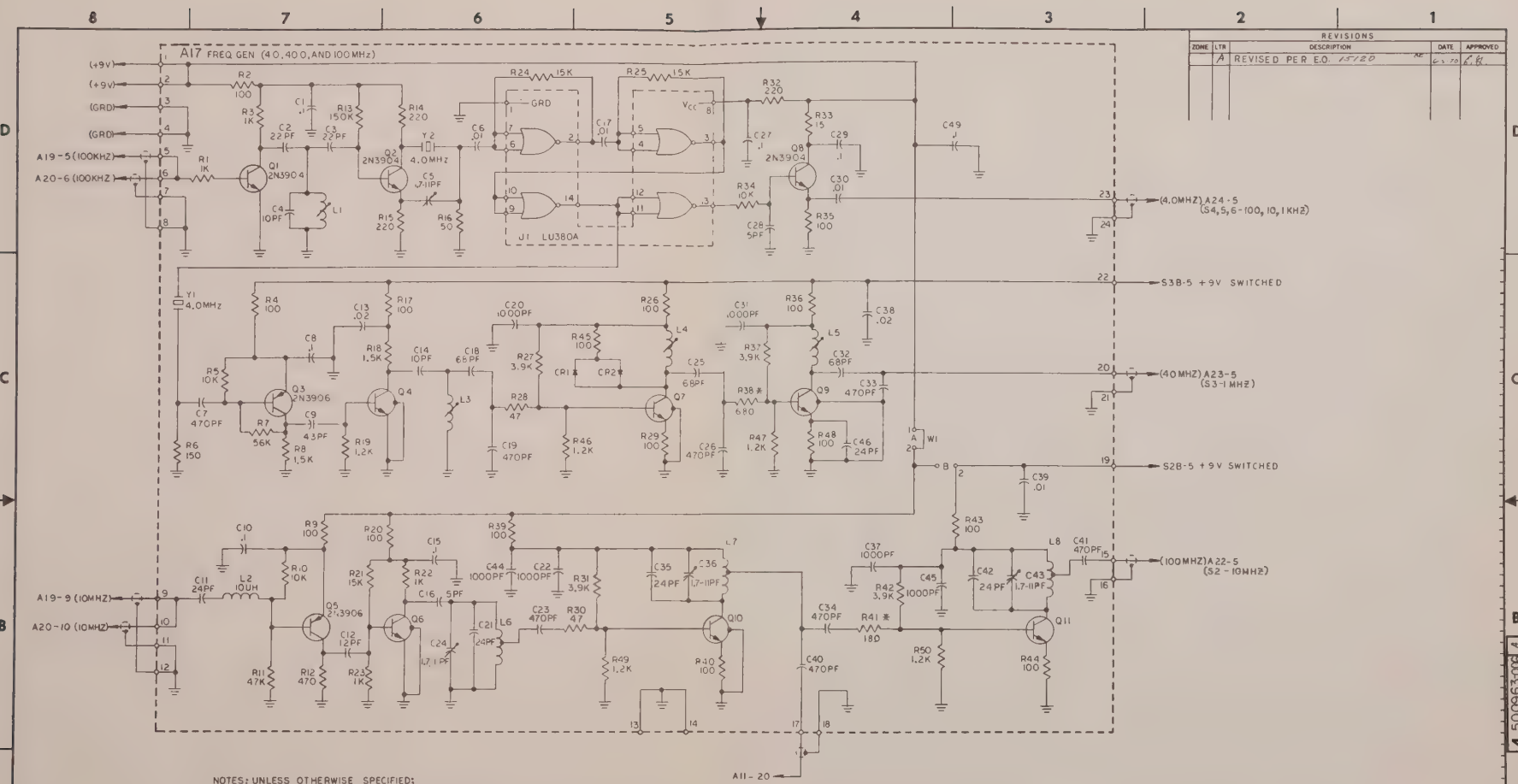
Figure 5-19. 4.1, 41 and 110MHz General Schematic Diagram (A16)


A17 FREQ GEN (40,400, AND 100MHz)
(+9V)
(+9V)
(GRD)
(GRD)
A19-5 (100KHZ)
A20-6 (100KHZ)
A19-9 (10MHZ)
A20-10 (10MHZ)
A11-20
J1 LU380A
(4.0MHZ) A24-5 (S4, 5, 6-100, 10, 1KHZ)
S3B-5 +9V SWITCHED
(40MHZ) A23-5 (S3-1MHZ)
S2B-5 +9V SWITCHED
(100MHZ) A22-5 (S2-10MHZ)
NOTES: UNLESS OTHERWISE SPECIFIED;
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO (A17), EXAMPLE A17 R1.
2. ALL RESISTORS VALUES ARE IN OHMS, ±10%, 1/4W.
3. ALL CAPACITORS VALUES ARE IN MICROFARADS.
4. ALL TRANSISTORS (Q) ARE 2N5179.
5. ALL DIODES (CR) ARE 1N4148.
6. * DENOTES FACTORY SELECTED VALUE.
REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
A | REVISED PER E.O. 15120
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C47, 48
REF DES NOT USED
CR2
L8
Q11
C49 Y2
R50 U1
LAST REF DES (INCLUSIVE)
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL ANGULAR
2 PLACE ± ~ ± ~
3 PLACE ± ~
MATERIAL
FINISH
MODEL NO. FM-10
CONTRACT NO.
DRAWN
CHECK
ELEC ENGR
MECH ENGR
APPROVED R.G. 10Dec69
SINGER
THE SINGER CO — METRICS DIV
GERTSCH DEPT. LOS ANGELES, CALIF
SCHEMATIC FREQ GEN (A17)
SIZE D | CODE IDENT NO. 88869 | DWG NO. 4-500963-006
SCALE ~ | SHEET 6 OF 10
4-500963-006 A

Figure 5-20. 4.0, 400 and 100MHz General Schematic Diagram (A17)

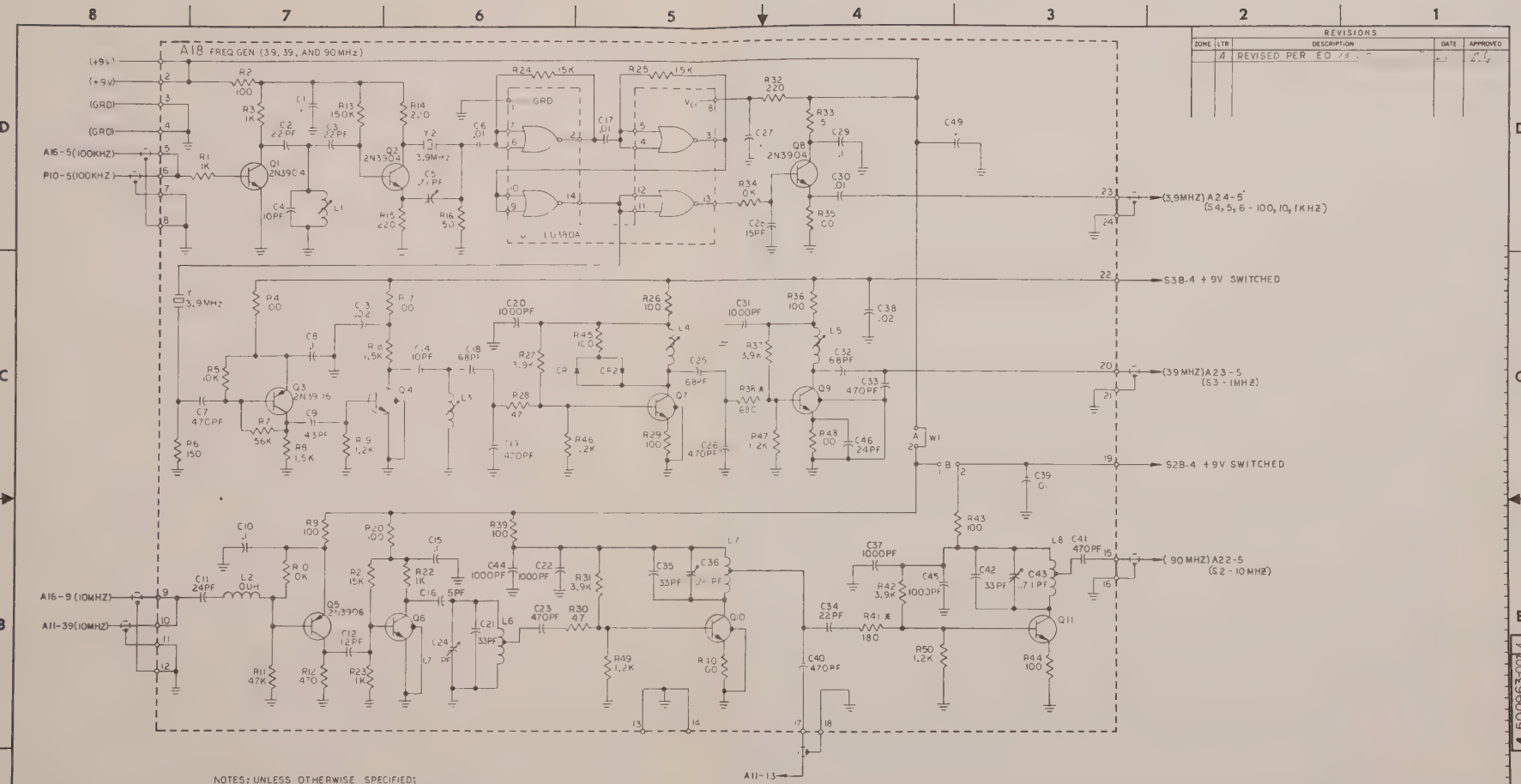
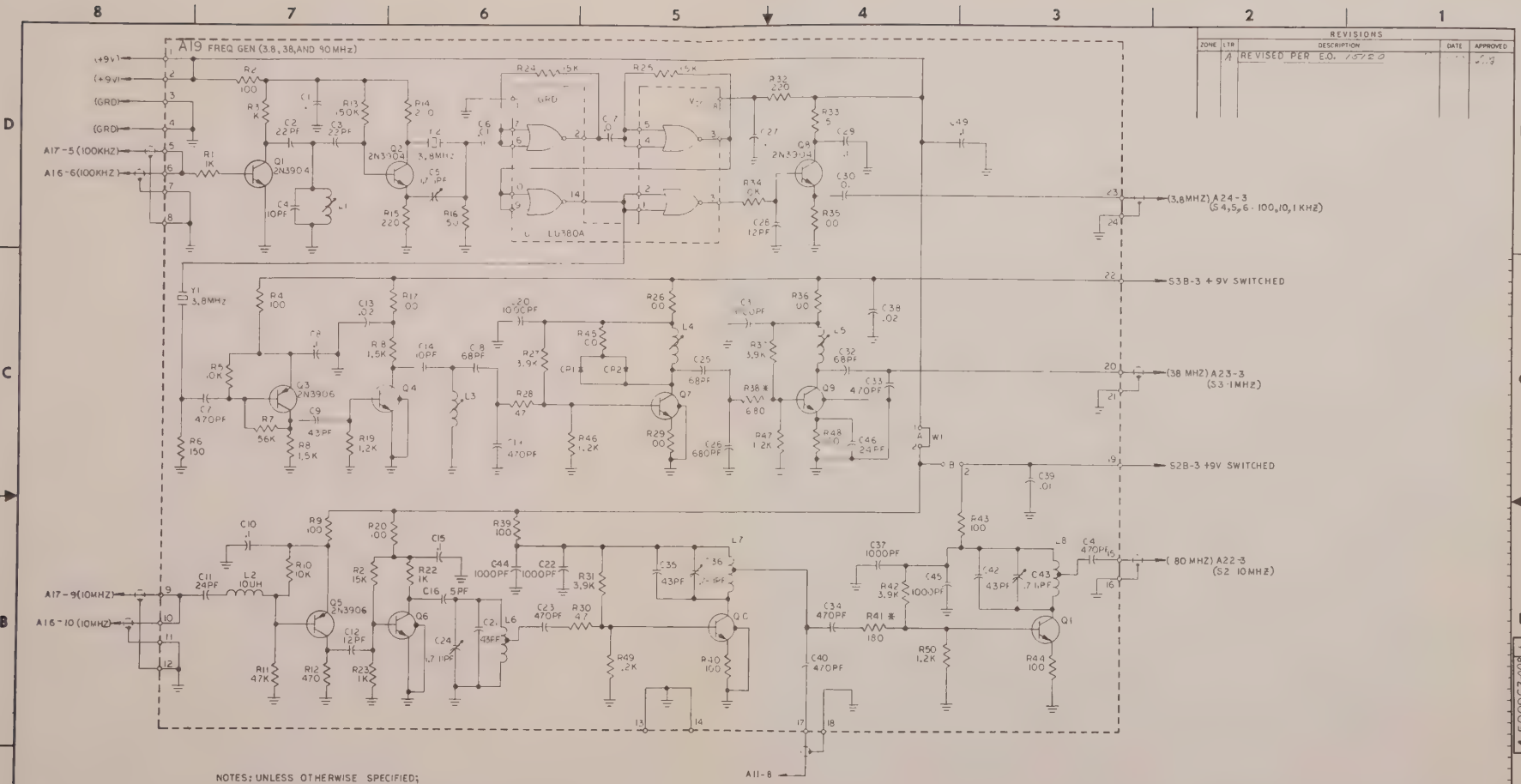


Figure 5-21. 3.9, 39 and 90MHz General Schematic Diagram (A18)


A19 FREQ GEN (3.8, 38, AND 90 MHz)
REVISIONS
ZONE LTR DESCRIPTION DATE APPROVED
A REVISED PER E.O. 15720
(+9V)
(+9V)
(GRD)
(GRD)
A17-5 (100KHZ)
A16-6 (100KHZ)
LM380A
(3.8MHZ) A24-3 (S4,5,6 - 100,10,1 KHZ)
S3B-3 +9V SWITCHED
(38 MHZ) A23-3 (S3 1MHZ)
S2B-3 +9V SWITCHED
(80 MHZ) A22-3 (S2 10MHZ)
A17-9 (10MHZ)
A16-10 (10MHZ)
A11-8
NOTES: UNLESS OTHERWISE SPECIFIED;
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO (A19), EXAMPLE A19 R1.
2. ALL RESISTORS VALUES ARE IN OHMS, ±10%, 1/4W.
3. ALL CAPACITORS VALUES ARE IN MICROFARADS.
4. ALL TRANSISTORS (Q) ARE 2N5179.
5. ALL DIODES (CR) ARE IN4148.
6. * DENOTES FACTORY SELECTED VALUE.
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LIST OF MATERIALS
SINGER
THE SINGER CO - METRICS DIV
GERTSCH DEPT. LOS ANGELES CALIF
SCHEMATIC FREQ GEN (A19)
SIZE D CODE IDENT NO 88869 DWG NO. 4-500963-008
SCALE ~ SHEET 8 OF 10
MODEL NO FM-10
4-500963-008 A

Figure 5-22. 3.8, 38 and 80MHz General Schematic Diagram (A19)

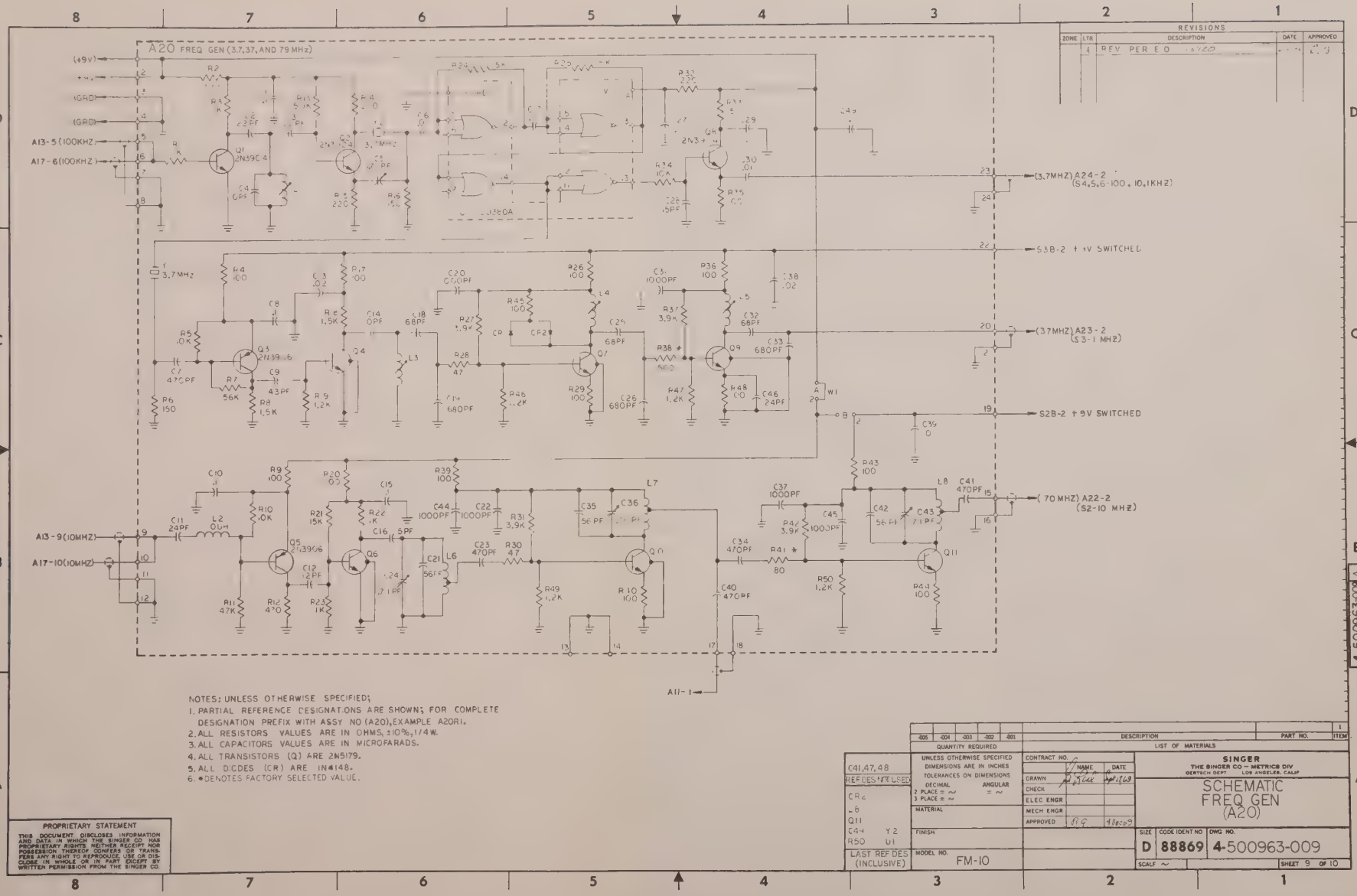
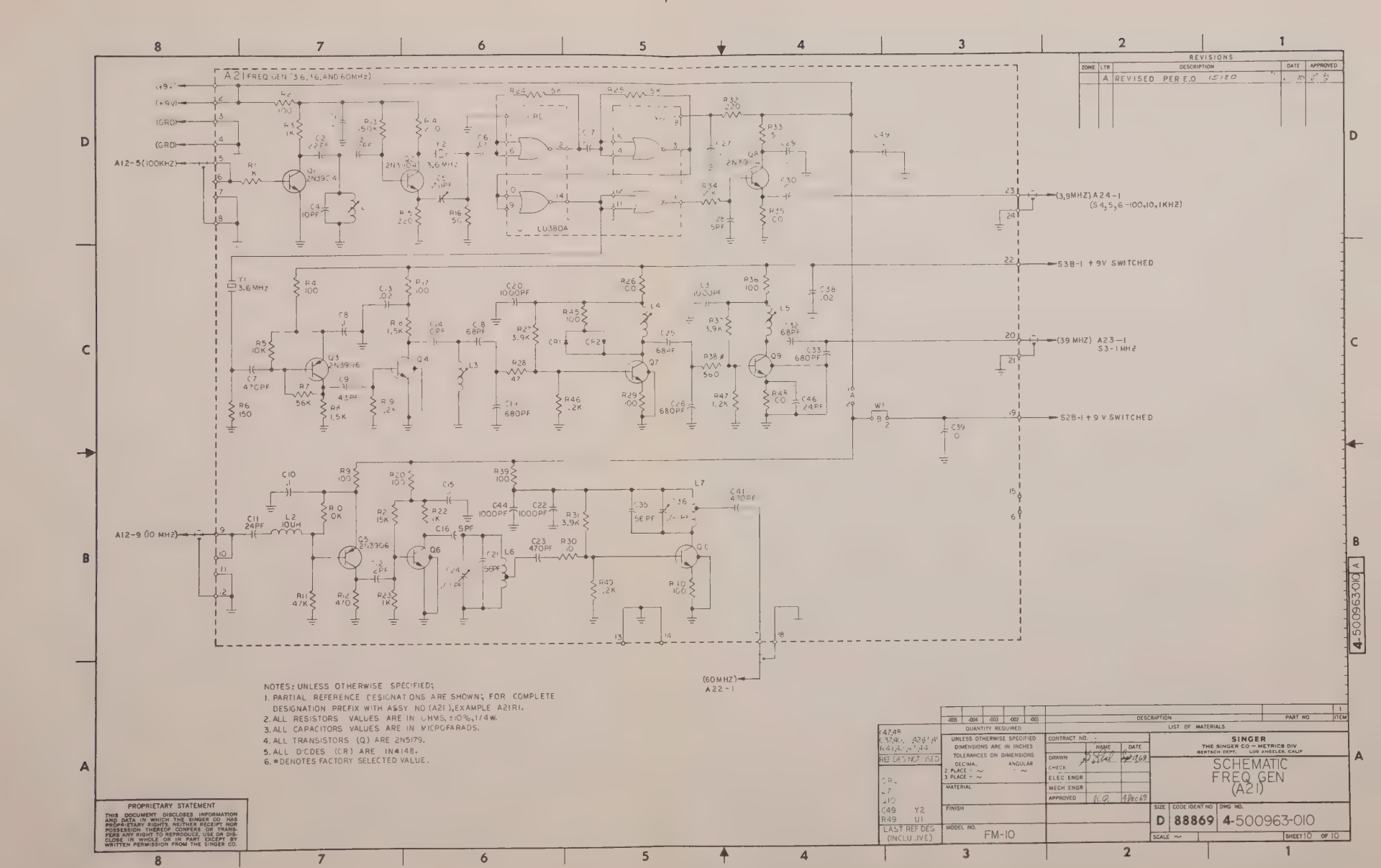


Figure 5-23. 3.7, 37 and 70MHz General Schematic Diagram (A20)


A21 (FREQ GEN 3.6, 36, AND 60MHz)
A12-5 (100KHZ)
A12-9 (10 MHZ)
(+9V)
(GRD)
LU380A
2N3904
2N3906
(3.9MHZ) A24-1
(S4, 5, 6 -100, 10, 1KHZ)
S3B-1 + 9V SWITCHED
(39 MHZ) A23-1
S3-1 MHz
S2B-1 + 9 V SWITCHED
(60MHZ)
A22-1
NOTES: UNLESS OTHERWISE SPECIFIED;
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO (A21), EXAMPLE A21R1.
2. ALL RESISTORS VALUES ARE IN OHMS, ±10%, 1/4W.
3. ALL CAPACITORS VALUES ARE IN MICROFARADS.
4. ALL TRANSISTORS (Q) ARE 2N5179.
5. ALL DIODES (CR) ARE IN4148.
6. *DENOTES FACTORY SELECTED VALUE.
REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
A | REVISED PER E.O 15120
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LIST OF MATERIALS
SINGER
THE SINGER CO – METRICS DIV
GERTSCH DEPT. LOS ANGELES, CALIF
SCHEMATIC
FREQ GEN
(A21)
CONTRACT NO.
DRAWN
CHECK
ELEC ENGR
MECH ENGR
APPROVED
MATERIAL
FINISH
MODEL NO. FM-10
SIZE D
CODE IDENT NO 88869
DWG NO. 4-500963-010
SCALE ~
SHEET 10 OF 10
4-500963-010 A

Figure 5-24. 3.6, 36 and 60MHz General Schematic Diagram (A21)

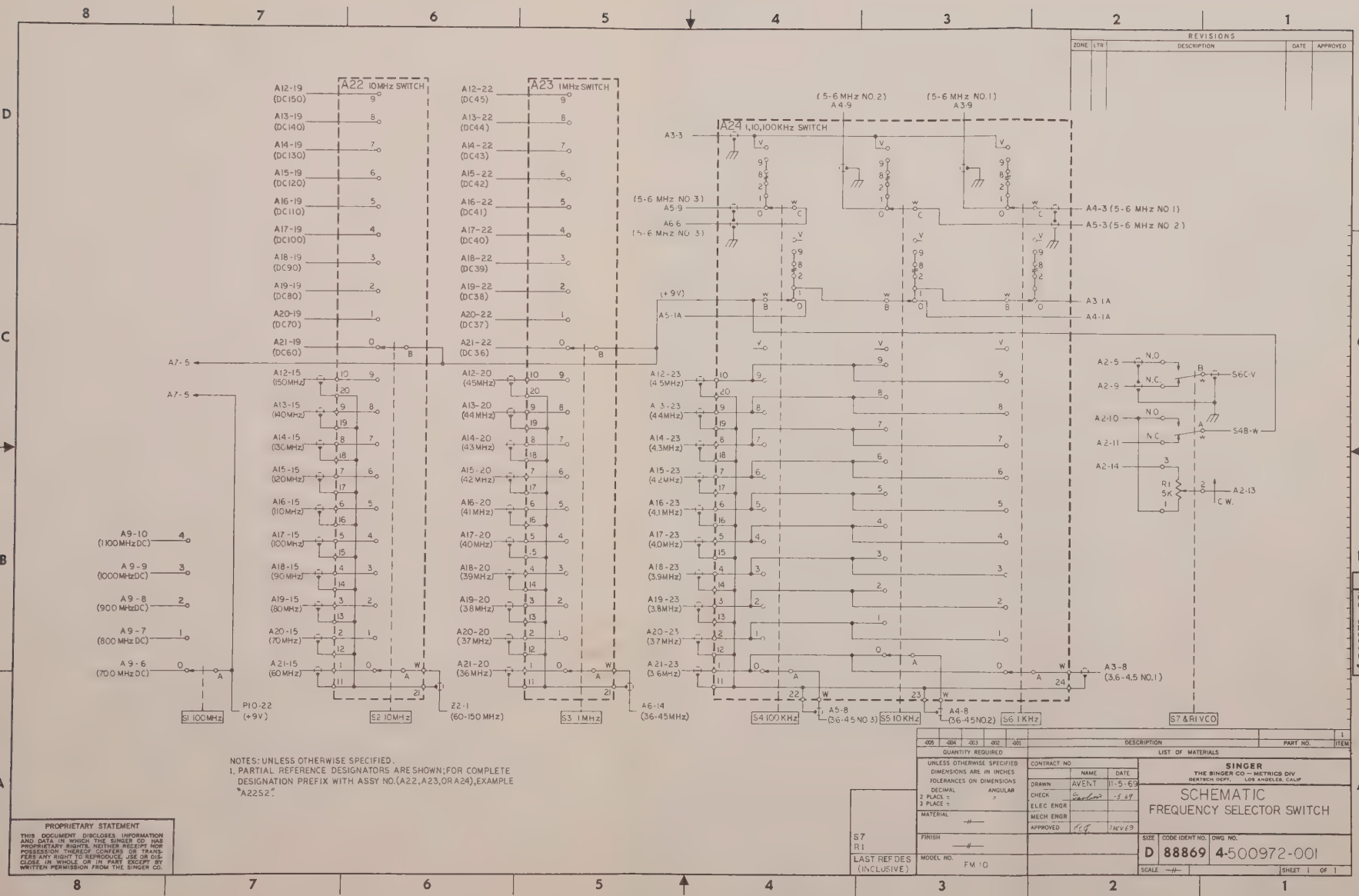
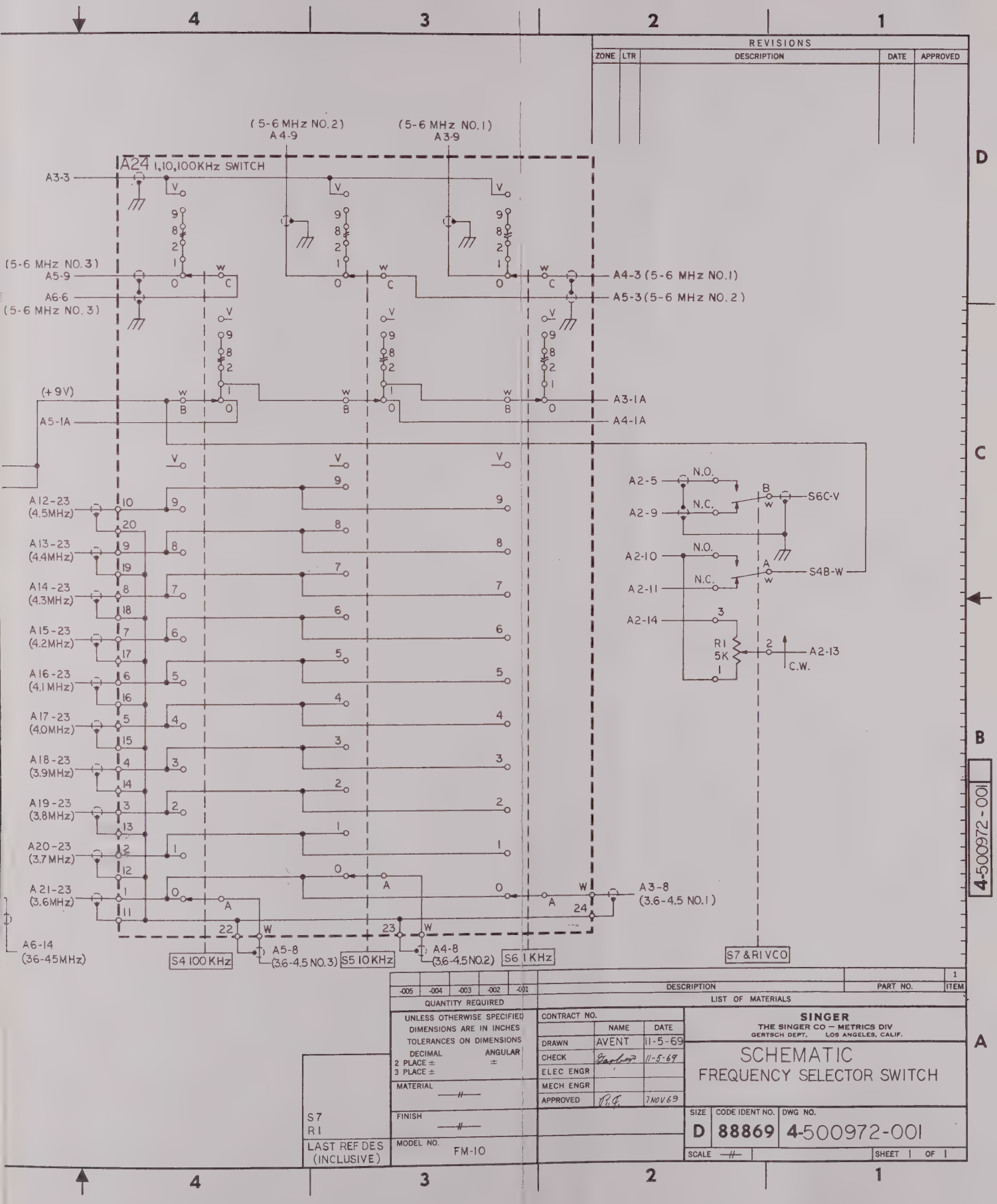


Figure 5-25. General Schematic Diagram 100MHz Switch (S1), 10MHz Switch (A22) 1MHz Switch (A23), 100, 10 and 1KHz Switches (A24), S7 and R1 VCO Control and Switch.



ic Diagram – 100MHz Switch (S1), 10MHz Switch (A22)
23), 100, 10 and 1KHz Switches (A24), S7 and R1 VCO
ch.

SECTION VI
PARTS LIST

MAIN ASSEMBLIES

REF DESIG	DESCRIPTION	P/N
A1	Left-Hand Module Assembly	4-003097-001
A2	VCO, 6 & 9 MHz Gen Assembly	5-003082-005
A3	1KHz Decade Assembly	5-003083-005
A4	10 KHz Decade Assembly	5-003083-006
A5	100 KHz Decade Assembly	5-003083-007
A6	1 MHz Decade Assembly	5-003084-005
A7-A8	Sub Assembly	4-003098-998
A9-A10	Sub Assembly	4-003098-999
A11	TCXO & Buffer Amp Assembly	5-003089-005
A12	4.5, 45 & 150 MHz Gen Assembly	5-003088-005
A13	4.4, 44 & 140 MHz Gen Assembly	5-003088-006
A14	4.3, 43 & 130 MHz Gen Assembly	5-003088-007
A15	4.2, 42 & 120 MHz Gen Assembly	5-003088-008
A16	4.1, 41 & 110 MHz Gen Assembly	5-003088-009
A17	4.0, 40 & 100 MHz Gen Assembly	5-003088-010
A18	3.9, 39 & 90 MHz Gen Assembly	5-003088-011
A19	3.8, 38 & 80 MHz Gen Assembly	5-003088-012
A20	3.7, 37 & 70 MHz Gen Assembly	5-003088-013
A21	3.6, 36 & 60 MHz Gen Assembly	5-003088-014
A22	10 MHz Switch Assembly (S2)	3-003105-005
A23	1 MHz Switch Assembly (S3)	3-003105-006
A24	100, 10 & 1KHz Switch Assembly (S4, S5 & S6)	4-003106-005

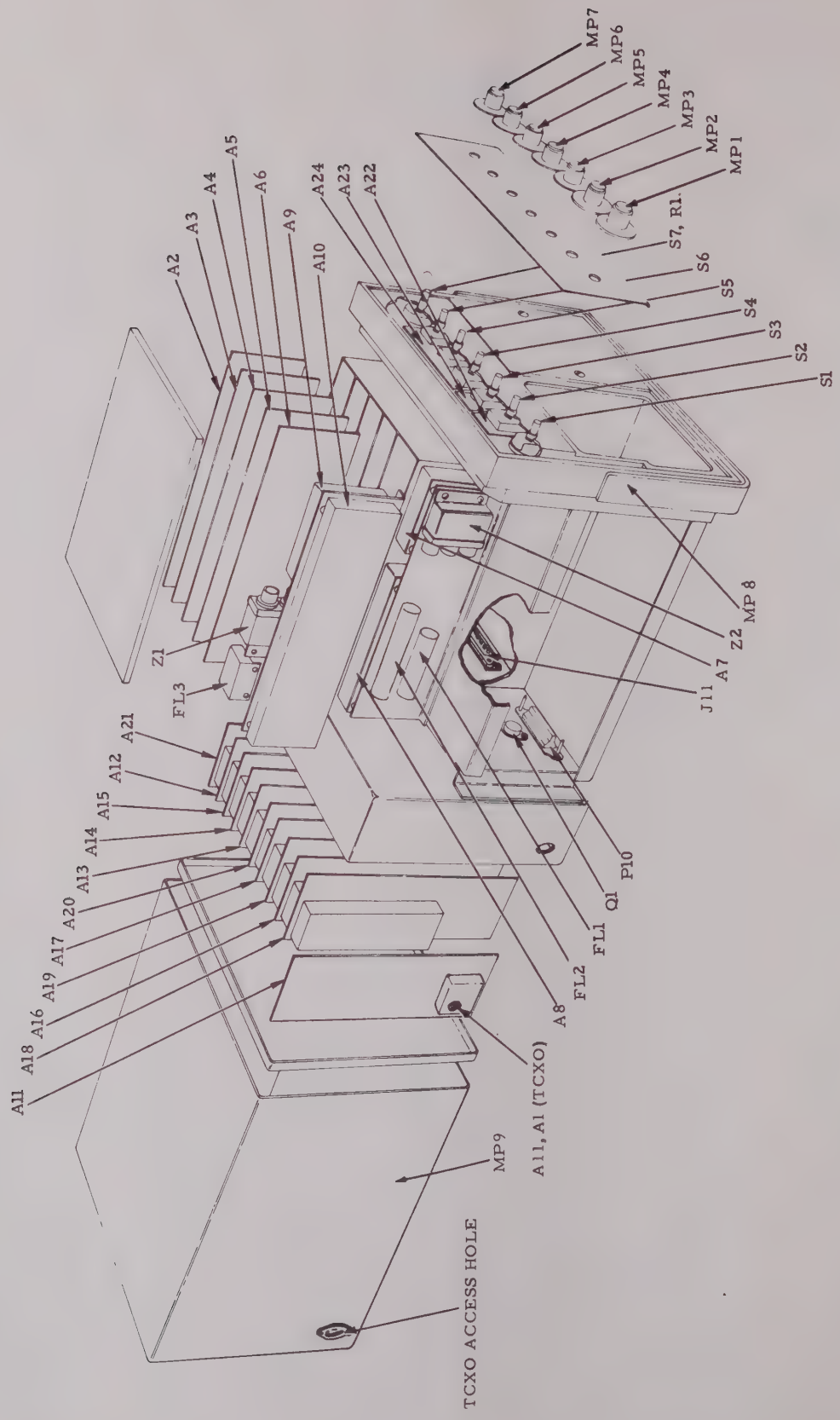


Figure 6-1. Exploded Isometric Diagram, Mainframe (A1 Removed)

ACCESSORIES

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY.
	Adapter, BNC to UHF	1-910117-001		–	1
	Adapter, 3-wire AC plug	1-910003-001	Bryant Electric	5272	1
	Antenna	3-001416-001	–	EM-24	1
	Attenuator, RFA-20	2-001355-001	–	–	2
	Cable, BNC to BNC (RG-58 C/U)	1-003159-001	–	–	1
	Power Cord, AC (8 ft.)	2-002978-001	–	–	1
	Power Cord, DC (6 ft.)	2-002979-001	–	–	1

MAINFRAME

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
A11 A1	TCXO crystal, 10MHz	1-402838-003	Austron	91707	1
FL1	Filter	1-402961-001	–	–	1
FL2	Filter	1-402960-001	–	–	1
FL3	Filter	2-003116-001	–	–	1
J11	Connector	1-910072-001	Amphenol	26-190-16	1
MP1	Dial Assy	3-301930-001	–	–	1
MP2 & MP3	Dial Assy	3-301930-002	–	–	2
MP4 to MP6	Dial Assy	3-301930-005	–	–	3
MP7	Knob	3-302109-001	–	–	1
MP8	Handle Assy	3-003096-001	–	–	1
MP9	Case	3-002774-001	–	–	1
P10	Connector	1-910071-002	Amphenol	26-159-24	1
Q1	Transistor	1-958039-001	Motorola	2N3055	1
S1	Switch	4-402881-001	–	–	1
S7 - R1	Resistor, variable, switched	4-403043-001	–	–	1
Z1 & Z2	Mixer	1-919009-001	Vari-L	DBM-210A	2

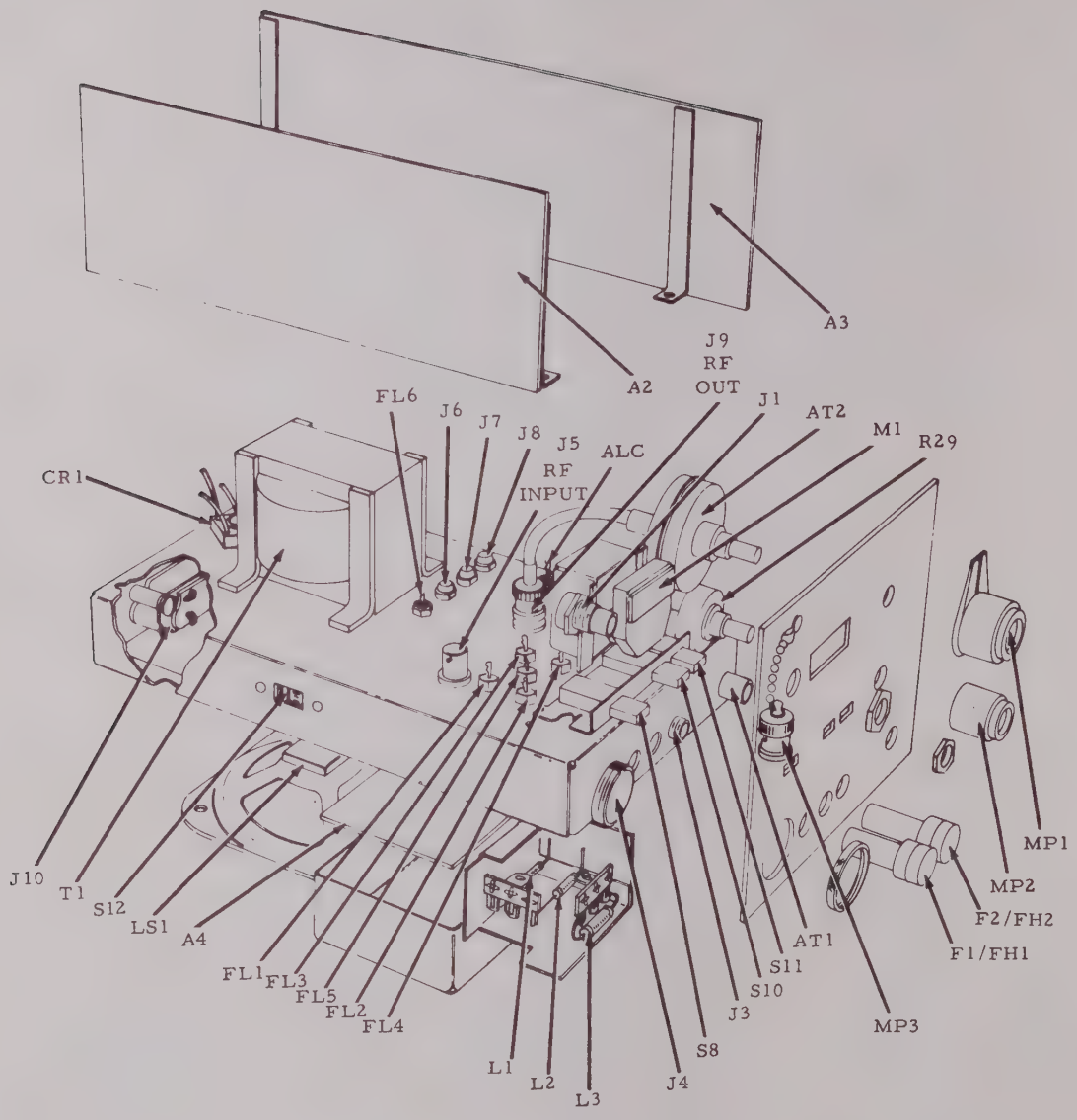


Figure 6-2. Exploded Isometric Diagram Assembly A1, Left-Hand Module

ASSEMBLY A1, LEFT-HAND MODULE

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
A2	Divider & Auto Control Assy	4-003078-005	–	–	1
A3	Power Supply, A.F. & I.F. Amp	4-003079-005	–	–	1
A4	Broad Band Amp & Detector Assy	4-003080-005	–	–	1
AT1	Attenuator RFA-20A	2-001355-002	–	–	1
AT2	Attenuator	2-002761-001	–	–	1
CR1	Diode Assembly	1-913025-001	Varo	W601	1
DS1, DS2	Lamp	1-925007-006	Mura	L-10/20	2
F1	Fuse, 3/4A	1-924000-017	Bussman	MDL	1
F2	Fuse, 4A	1-924000-029	Bussman	MDL	1
FH1, FH2	Fuseholder	1-924003-002	Bussman	HKP	2
FL1-FL6	Filter	1-919011-004	Erie Electronics	1202-051	6
J1 (SN101-400)	Connector, BNC	1-910017-007	Dage Electric	2230	1
J1 (SN401 and up)	Connector, BNC	1-910043-002	Kings Electronics	KC-19-93	1
J2	Connector	Part of AT1			1
J3	Connector	1-910077-001	Switchcraft	L112A	1
J4	Connector	1-910088-001	Amphenol	91PC4M	1
J5 (SN101-400)	Connector, BNC	1-910017-007	Dage Electric	2230	1
J5 (SN401 and up)	Connector, BNC	1-910043-002	Kings Electronics	KC-19-93	1
J6-J8	Connector	1-910026-001	Switchcraft	3C1054A	3
J9 (SN101-400)	Connector	1-910017-007	Dage Electric	2230	1
J9 (SN401 and up)	Connector, BNC	1-910043-002	Kings Electronics	KC-19-93	1
J10	Connector	1-910072-002	Amphenol	26-190-24	1
L2	Choke, 3.9 μH	1-906002-008	–	–	2

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
L3	Choke, 1.8 μH	1-906009-001	J.W. Miller	–	1
LS1	Loudspeaker	1-936001-001	Quam	597-1	1
M1	Meter	1-937003-001	Mura	TS-151	1
MP1	Knob	1-935011-001	Buckeye	–	1
MP2	Knob	1-935002-002	Buckeye	RSSN-70-2	1
MP3	Cap, BNC Connector	1-910118-001	Dage Electric	366-1	1
R29	Resistor, variable	1-945009-001	CTS	Series 45	1
S8, S10, S11	Switch Assembly	1-951024-001	–	–	1
S12	Switch	1-951003-001	Switchcraft	46206LF	1
T1	Transformer	1-402835-001	–	–	1

ASSEMBLY A1A2, DIVIDER & AUTO LEVEL CONTROL

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C1,C2	Capacitor, .01 UF	1-900001-001	Amperex	Type C280AE	2
C3	Capacitor, .1 UF	1-900001-013	Amperex	Type C280AE	1
C4	Capacitor, .047 UF	1-900001-009	Amperex	Type C280AE	1
C5	Capacitor, 47 PF	1-900003-021	Electro Motive	Type DM 15	1
C6,C7	Capacitor, .1 UF	1-900001-013	Amperex	Type C280AE	2
C8	Capacitor, 100 PF	1-900003-030	Electro Motive	Type DM 15	1
C9	Capacitor, .01 UF	1-900001-001	Amperex	Type C280AE	1
C10,C11,C12	Capacitor, .1 UF	1-900001-013	Amperex	Type C280AE	3
C13	Capacitor, 200 UF	1-900039-002	Gen. Instru. Corp.	984-141	1
C14	Capacitor, .005 UF	1-900012-004	Erie	801Z5U502Z	1
C15	Capacitor, .1 UF	1-900001-013	Amperex	Type C280AE	1
C16	Capacitor, 2.0 UF	1-900026-035	SEI Mfg.	Type 17W	1
C17 C18	Capacitor, .1 UF	1-900001-013	Amperex	Type C280AE	1
C19	Capacitor, .1 UF	1-900001-013	Amperex	Type C280AE	1
C20,C21,C22	Capacitor, .1 UF	1-900001-013	Amperex	Type C280AE	3
C23,C24	Capacitor, 1000 PF	1-900003-056	Electro Motive	Type DM 15	2
C25,C26,C27	Capacitor, .1 UF	1-900001-013	Amperex	Type C280AE	3
CR4,5,6	Diode 1N4148	1-913007-001	GE	1N4148	3
Q1-Q6	Transistor, 2N3904	1-958000-001	Motorola	2N3904-5	6
Q7	Transistor, 2N3906	1-958000-002	Motorola	2N3906-5	1
Q8	Transistor, 2N3904	1-958000-001	Motorola	2N3904-5	1
R1	Resistor, Carbon 1.8 K	1-945000-040	Allen-Bradley	Type CB HA-01121	1
R2	Resistor, Carbon 100 Ω	1-945000-025	Allen-Bradley	Type CB HA-01121	1
R3	Resistor, Carbon 470 Ω	1-945000-033	Allen-Bradley	Type CB HA-01121	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R4	Resistor, Carbon 10 K	1-945000-049	Allen-Bradley	Type CB HA-01121	1
R5	Resistor, Carbon 3.3 K	1-945000-043	Allen-Bradley	Type CB HA-01121	1
R6	Resistor, Carbon 10 Ω	1-945000-013	Allen-Bradley	Type CB HA-01121	1
R7	Resistor, Carbon 4.7 K	1-945000-045	Allen-Bradley	Type CB HA-01121	1
R8	Resistor, Carbon 1 K	1-945000-037	Allen-Bradley	Type CB HA-01121	1
R9	Resistor, Carbon 1.2 K	1-945000-038	Allen-Bradley	Type CB HA-01121	1
R10	Resistor, Carbon 100 Ω	1-945000-025	Allen-Bradley	Type CB HA-01121	1
R11	Resistor, Carbon 470 Ω	1-945000-033	Allen-Bradley	Type CB HA-01121	1
R12	Resistor, Carbon 180 Ω	1-945000-028	Allen-Bradley	Type CB HA-01121	1
R13	Resistor, Carbon 470 Ω	1-945000-033	Allen-Bradley	Type CB HA-01121	1
R14	Resistor, Carbon 1 K	1-945000-037	Allen-Bradley	Type CB HA-01121	1
R15	Resistor, Carbon 180 Ω	1-945000-028	Allen-Bradley	Type CB HA-01121	1
R16	Resistor, Carbon 100 Ω	1-945000-025	Allen-Bradley	Type CB HA-01121	1
R17	Resistor, Carbon 1 K	1-945000-037	Allen-Bradley	Type CB HA-01121	1
R18	Resistor, Carbon 180 Ω	1-945000-028	Allen-Bradley	Type CB HA-01121	1
R19	Resistor, Carbon 4.7 K	1-945000-045	Allen-Bradley	Type CB	1
R20	Resistor, Film 12.1 K	1-945016-297		RN60	
R21,R22	Resistor, Film 2.21 K	1-945016-226		RN60	2

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R23	Resistor, Film 5.11 K	1-945016-261		RN60	1
R24	Resistor, Film 22.1 K	1-945016-322		RN60	1
R25					
R26	Resistor, Carbon 47 Ω	1-945000-021	Allen-Bradley	Type CB	1
R27	Resistor, Film 4.32 K	1-945016-254		RN60	
R28,R29	Resistor, Carbon 4.7 K	1-945000-045	Allen-Bradley	Type CB	2
R30					
R31	Resistor, Carbon 1 K	1-945039-007	Amphenol	Type 3800	1
R32					
R33	Resistor, Carbon 22 Ω	1-945000-017	Allen-Bradley	Type CB	1
R34	Resistor, Carbon 15 K	1-945000-051	Allen-Bradley	Type CB	1
R35					
R36	Resistor, Carbon 22 Ω	1-945000-017	Allen-Bradley	Type CB	1
R37,R38	Resistor, Carbon 4.7 K	1-945000-045	Allen-Bradley	Type CB	2
R39	Resistor, Carbon 10 Ω	1-945000-013	Allen-Bradley	Type CB	1
R40	Resistor, Carbon 1.8 K	1-945000-040	Allen-Bradley	Type CB	1
R41	Resistor, Film 5.11 K	1-945016-261		RN60	
R42	Resistor, Film, 4.32 K	1-945016-254		RN60	
R43	Resistor, Film 12.1 K	1-945016-297		RN60	
U1,2,3,4	Integrated Ckt LU322B	1-926021-001	Signetics Corp	LU322B	4
U5,6	Integrated Ckt CA3028A	1-926005-001	RCA	CA3028A	2

ASSEMBLY A1A3, POWER SUPPLY A.F. & I.F. AMP.

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C1,C2	Capacitor, 1500 UF, 25 V	1-900040-002	General Instr. Corp. Capacitor Grp.	977-206	2
C3	Capacitor 1 UF	1-900026-033	SEI Mfg	Type 17W	1
C4,C5	Capacitor 25 UF 15 V	1-900039-001	Gen. Instr. Corp Capacitor Grp.	984-118	2
C6	Capacitor .47 UF	1-900001-021	Amperex	Type 280AE	1
C7	Capacitor 25 UF 15 V	1-900039-001	Gen. Instr. Corp Capacitor Grp.	984-118	1
C8 C9 C10	Capacitor 200 UF 15 V	1-900039-002	Gen. Instr. Corp Capacitor Grp.	984-141	3
C11 C12	Capacitor 25 UF 15 V	1-900039-001	Gen. Instr. Corp Capacitor Grp	984-118	2
C13	Capacitor .047	1-900001-009	Amperex	Type 280AE	1
C14	Capacitor 150 PF	1-900003-034	Electromotive Mfg	Type DM15	1
C15	Capacitor 250 PF	1-900003-040	Electromotive Mfg	Type DM 15	1
C16	Capacitor .022 UF	1-900001-005	Amperex	Type 280AE	1
C17	Capacitor 200 UF 15 V	1-900039-002	Gen. Instr. Corp Capacitor Grp	984-141	1
C18	Capacitor .001	1-900012-002	Erie	8612SU102P	1
C19	Capacitor 100 PF	1-900003-030	Electromotive Mfg	Type DM 15	1
C20	Capacitor 25 UF 15 V	1-900039-001	Gen Instr Corp Capacitor Grp.	984-118	1
C21	Capacitor .047	1-900001-009	Amperex	Type 280AE	1
C22	Capacitor 1000 UF 15 V	1-900040-001	General Instr. Corp Capacitor Grp	977-188	1
CR1	Diode MZ1000	1-913004-216	Motorola	Type M2	1
CR2	Diode E1	1-913002-001	Sarkes Tarzian	Type E1	1
CR3	Diode MZ1000	1-913004-011	Motorola	Type M2	1
CR4	Diode MZ1000	1-913004-006	Motorola	Type M2	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
CR5	Diode 1N4148	1-913007-001	GE	Type 1N4148	1
CR6	Diode 1N273	1-913005-001	Transitron Electronic Grp.	1N273	1
L1	Coil	1-906006-033	Precision Coil Co.	–	1
Q1	Transistor MJE 520	1-958001-002	Motorola	MJE 520	1
Q2	Silicon Cont Rect	1-958042-002	Motorola	2N4184	1
Q3	Transistor MJE 520	1-958001-002	Motorola	MJE 520	1
Q4	Transistor MJE 370	1-958001-001	Motorola	MJE 370	1
Q5-Q10	Transistor 2N3904	1-958000-001	Motorola	2N3904	6
Q11	Transistor 2N3906	1-958000-002	Motorola	2N3906	1
R1	Resistor, Carbon 470	1-945000-033	Allen Bradley Co	Type CB	1
R2	Resistor, Carbon 47	1-945000-021	Allen Bradley Co	Type CB	1
R3	–	–			–
R4	Resistor, Carbon 390	1-945000-032	Allen Bradley Co	Type CB	1
R5	Resistor, Carbon 100	1-945000-025	Allen Bradley Co	Type CB	1
R6	Resistor, Carbon 1 K	1-945000-037	Allen Bradley Co	Type CB	1
R7	Resistor, Carbon 4.7 K	1-945000-045	Allen Bradley Co	Type CB	1
R8	Resistor, Carbon 270	1-945000-030	Allen Bradley Co	Type CB	1
R9	Resistor, Carbon 1 K	1-945000-037	Allen Bradley Co	Type CB	1
R10	–	–		–	
R11	Resistor, Carbon 1.5 K	1-945000-039	Allen Bradley Co	Type CB	1
R12	Resistor, Carbon 470	1-945000-033	Allen Bradley Co	Type CB	1
R13	Resistor, Carbon 220	1-945000-029	Allen Bradley Co	Type CB	1
R14	Resistor, Carbon 470	1-945000-033	Allen Bradley Co	Type CB	1
R15-R17	–	–	–	–	
R18	Resistor, Carbon 2.2 K	1-945000-041	Allen Bradley Co	Type CB	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R19	Resistor, Carbon 33 K	1-945000-055	Allen Bradley Co	Type CB	1
R20	Resistor, Carbon 4.7 K	1-945000-045	Allen Bradley Co	Type CB	1
R21	Resistor, Carbon 3.3 K	1-945000-043	Allen Bradley Co	Type CB	1
R22	Resistor, Carbon 100	1-945000-025	Allen Bradley Co	Type CB	1
R23	Resistor, Carbon 3.3 K	1-945000-043	Allen Bradley Co	Type CB	1
R24	Resistor, Carbon 3.9 K	1-945000-044	Allen Bradley Co	Type CB	1
R25	Resistor, Carbon 2.2 K	1-945000-041	Allen Bradley Co	Type CB	1
R26		—		—	
R27	Resistor, Carbon 27 K	1-945000-054	Allen Bradley Co	Type CB	1
R28	Resistor, Carbon 6.8 K	1-945000-047	Allen Bradley Co	Type CB	1

ASSEMBLY A1A4, BROAD BAND AMP & DETECTOR

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C1-C9	Capacitor .1 UF	1-900001-013	Amperex	Type C280AE	9
C10	Capacitor .001 UF	1-900012-002	Erie	861Z5U102P	1
C11	Capacitor .1 UF	1-900001-013	Amperex	Type C280AE	1
C12	Capacitor 150 PF	1-900003-034	Electro Motive Mfg.	Type DM 15	1
C13	Capacitor 2 PF	1-900003-002	Electro Motive Mfg.	Type DM 15	1
C15	Capacitor .047 UF	1-900001-013	Amperex	Type C280AE	1
CR1 CR2	Diode BD3	1-913026-003	GE	BD-3	2
L1	Coil 3T	1-402869-002			1
L2	Coil 3T	1-402869-001			1
L3	Coil .22 UH	1-906008-001	Wilco Corp.	H4-99848	1
L4,L5	Coil 3T	1-402869-001			2
Q1-Q3	Transistor 2N5179	1-958018-001	RCA	Type 2N5179	3
R1	Resistor, Carbon 82	1-945000-024	Allen-Bradley	Type CB	1
R2	Resistor, Carbon 390	1-945000-032	Allen-Bradley	Type CB	1
R3	Resistor, Carbon 22 K	1-945000-053	Allen-Bradley	Type CB	1
R4	Resistor, Carbon 4.7 K	1-945000-045	Allen-Bradley	Type CB	1
R5	Resistor, Carbon 470	1-945000-033	Allen-Bradley	Type CB	1
R6	Resistor, Carbon 4.7 K	1-945000-045	Allen-Bradley	Type CB	1
R7	Resistor, Carbon 10	1-945000-013	Allen-Bradley	Type CB	1
R8	Resistor, Carbon 47	1-945000-021	Allen-Bradley	Type CB	1
R9	Resistor, Carbon 22 K	1-945000-053	Allen-Bradley	Type CB	1
R10,R11	Resistor, Carbon 470	1-945000-033	Allen-Bradley	Type CB	2
R12	Resistor, Carbon 4.7 K	1-945000-045	Allen-Bradley	Type CB	1
R13	Resistor, Carbon 10	1-945000-013	Allen-Bradley	Type CB	1
R14	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R15	Resistor, Carbon 15 K	1-945000-051	Allen-Bradley	Type CB	1
R16	Resistor, Carbon 270	1-945000-030	Allen-Bradley	Type CB	1
R17	Resistor, Carbon 47	1-945000-021	Allen-Bradley	Type CB	1
R18	Resistor, Carbon 470	1-945000-033	Allen-Bradley	Type CB	1
R19	Resistor, Carbon 10 K	1-945000-049	Allen-Bradley	Type CB	1
R20	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R21	Resistor, Carbon 470	1-945000-033	Allen-Bradley	Type CB	1
R22	Resistor, Carbon 820	1-945000-036	Allen-Bradley	Type CB	1
R23	Resistor, Carbon 270	1-945000-030	Allen-Bradley	Type CB	1
R24	Resistor, Carbon 4.7 K	1-945000-045	Allen-Bradley	Type CB	1
R25	Resistor, Carbon 470	1-945000-033	Allen-Bradley	Type CB	1
R26	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R27	Resistor 68 Ω	1-945000-023	Allen-Bradley	Type CB	1
R28	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1

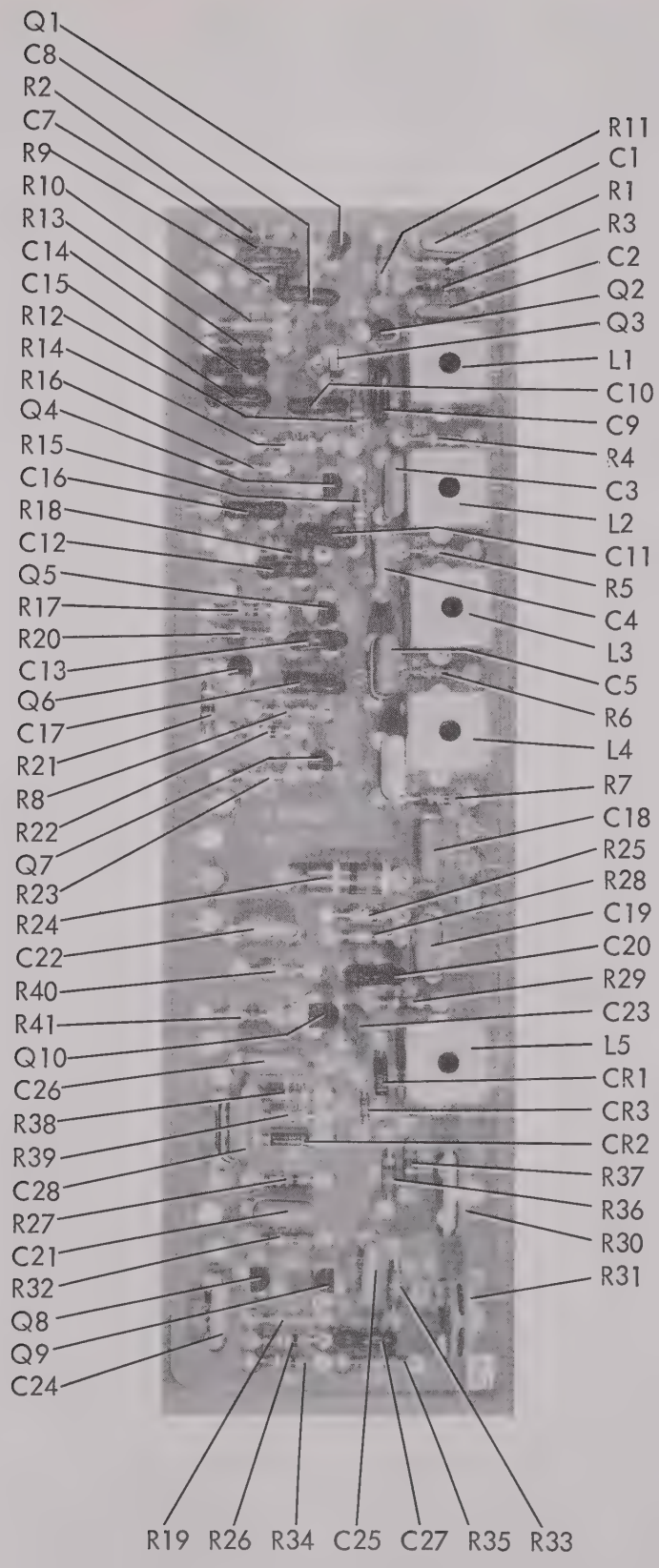


Figure 6-3. Parts Locations, Assembly A2

ASSEMBLY A2, VCO, 6 & 9 MHz GENERATOR

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C1	Capacitor .01 UF	1-900001-001	Amperex	C280AE	1
C2-C4	Capacitor .022 UF	1-900001-005	Amperex	C280AE	3
C5	Capacitor .1 UF	1-900001-013	Amperex	C280AE	1
C6	Capacitor .047 UF	1-900001-009	Amperex	C280AE	1
C7	Capacitor 100 PF	1-900003-030	Electromotive	DM15	1
C8	Capacitor 22 PF	1-900003-013	Electromotive	DM15	1
C9-C11	Capacitor 56 PF	1-900003-024	Electromotive	DM15	3
C12	Capacitor 33 PF	1-900003-017	Electromotive	DM15	1
C13	Capacitor 270 PF	1-900003-041	Electromotive	DM15	1
C14-C16	Capacitor 1000 PF	1-900003-056	Electromotive	DM15	3
C17	Capacitor 470 PF	1-900003-047	Electromotive	DM15	1
C18,C19	Capacitor .1 UF	1-900001-013	Amperex	C280AE	2
C20	Capacitor 200 PF	1-900003-037	Electromotive	DM15	1
C21	Capacitor .1 UF	1-900001-013	Amperex	C280AE	1
C22	Capacitor .01 UF	1-900001-001	Amperex	C280AE	1
C23	Capacitor 10 PF, N750	1-900067-001	Erie	831-000 U2J0 100D	1
C24,C25	Capacitor .01 UF	1-900001-001	Amperex	C280AE	2
C26	Capacitor .1 UF	1-900001-013	Amperex	C280AE	1
C27	Capacitor 1000 PF	1-900003-056	Electro Motive	DM15	1
C28	Capacitor .1 UF	1-900001-013	Amperex	C280AE	1
CR1,CR2	Diode MV840	1-913029-011	Motorola	MV840	2
CR3	Diode 1N 4148	1-913007-001	G.E.	1N 4148	1
L1-L4	Coil LR45	1-906006-005	Precision Coil	LR45	4
L5	Coil LR24	1-906006-004	Precision Coil	LR24	1
Q1	Transistor	1-958000-002	Motorola	2N3906	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
Q2,3,4,5 6,7	Transistor	1-958000-001	Motorola	2N3904	6
Q8	Transistor	1-958000-002	Motorola	2N3906	1
Q9	Transistor	1-958000-001	Motorola	3N3904	1
Q10	Transistor	1-958046-001		MPS 6597	1
R1	Resistor Carbon 100 10%	1-945000-025	Allen-Bradley	Type CB	1
R2	Resistor Carbon 470 10%	1-945000-033	Allen-Bradley	Type CB	1
R3	Resistor Carbon 100 10%	1-945000-025	Allen-Bradley	Type CB	1
R4,R5	Resistor Carbon 560 10%	1-945000-034	Allen-Bradley	Type CB	2
R6,R7	Resistor Carbon 100 10%	1-945000-025	Allen-Bradley	Type CB	2
R8	Resistor Carbon 3.3 K 10%	1-945000-043	Allen-Bradley	Type CB	1
R9	Resistor Carbon 1 K 10%	1-945000-037	Allen-Bradley	Type CB	1
R10	Resistor Carbon 150 10%	1-945000-027	Allen-Bradley	Type CB	1
R11	Resistor Carbon 270 10%	1-945000-030	Allen-Bradley	Type CB	1
R12	Resistor Carbon 270 K 10%	1-945000-066	Allen-Bradley	Type CB	1
R13	Resistor Carbon 270 10%	1-945000-030	Allen-Bradley	Type CB	1
R14	Resistor Carbon 470 10%	1-945000-033	Allen-Bradley	Type CB	1
R15	Resistor Carbon 270 K 10%	1-945000-066	Allen-Bradley	Type CB	1
R16	Resistor Carbon 270 10%	1-945000-030	Allen-Bradley	Type CB	1
R17	Resistor Carbon 1 K 10%	1-945000-037	Allen-Bradley	Type CB	1
R18	Resistor Carbon 47 10%	1-945000-021	Allen-Bradley	Type CB	1
R19	Resistor Carbon 10 K 10%	1-945000-049	Allen-Bradley	Type CB	1
R20	Resistor Carbon 2.2 K 10%	1-945000-021	Allen-Bradley	Type CB	1
R21	Resistor Carbon 47 10%	1-945000-041	Allen-Bradley	Type CB	1
R22	Resistor Carbon 100 K 10%	1-945000-061	Allen-Bradley	Type CB	1
R23	Resistor Carbon 330, 10%	1-945000-031	Allen-Bradley	Type CB	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R24	Resistor Carbon 47 Ω, 1 W	1-945002-021	Allen-Bradley	Type GB	1
R25	Resistor Carbon 15 K, 10%	1-945000-051	Allen-Bradley	Type CB	1
R26	Resistor Carbon 180 10%	1-945000-028	Allen-Bradley	Type CB	1
R27	Resistor Carbon 100 10%	1-945000-025	Allen-Bradley	Type CB	1
R28	Resistor Carbon 10 K 10%	1-945000-049	Allen-Bradley	Type CB	1
R29,	Resistor Carbon 4.7 K 10%	1-945000-045	Allen-Bradley	Type CB	1
R30	Resistor Var 2.5 K	1-945007-005	Allen-Bradley	Type CB	1
R31	Resistor Var 1 K	1-945007-004	Chicago Tel. Supply	Type X201	2
R32	Resistor Carbon 1 K, 10%	1-945000-037	Allen-Bradley	Type CB	1
R33	Resistor Carbon 27 K 10%	1-945000-054	Allen-Bradley	Type CB	1
R34	Resistor Carbon 100 10%	1-945000-025	Allen-Bradley	Type CB	1
R35	Resistor Carbon 10 K 10%	1-945000-049	Allen-Bradley	Type CB	1
R36	Resistor Carbon .1 Meg 10%	1-945000-073	Allen-Bradley	Type CB	1
R37	Resistor Carbon 6.8 K 10%	1-945000-047	Allen-Bradley	Type CB	1
R38,R39	Resistor Carbon 47 K 10%	1-945000-057	Allen-Bradley	Type CB	2
R40	Resistor Carbon 15 K 10%	1-945000-051	Allen-Bradley	Type CB	1
R41	Resistor Carbon 3.9 K 10%	1-945000-044	Allen-Bradley	Type CB	1
R42	Resistor Carbon 1 K 10%	1-945000-037	Allen-Bradley	Type CB	1
R43	Resistor Carbon 3.3 K 10%	1-945000-043	Allen-Bradley	Type CB	1
R44	Resistor Var 5 K	1-945007-006	Chicago Tel. Supply	Type X201	1
R45	Resistor Carbon 470, 10%	1-945000-033	Allen-Bradley	Type CB	1
R46	Resistor Carbon 4.7 K 10%	1-945000-045	Allen-Bradley	Type CB	1

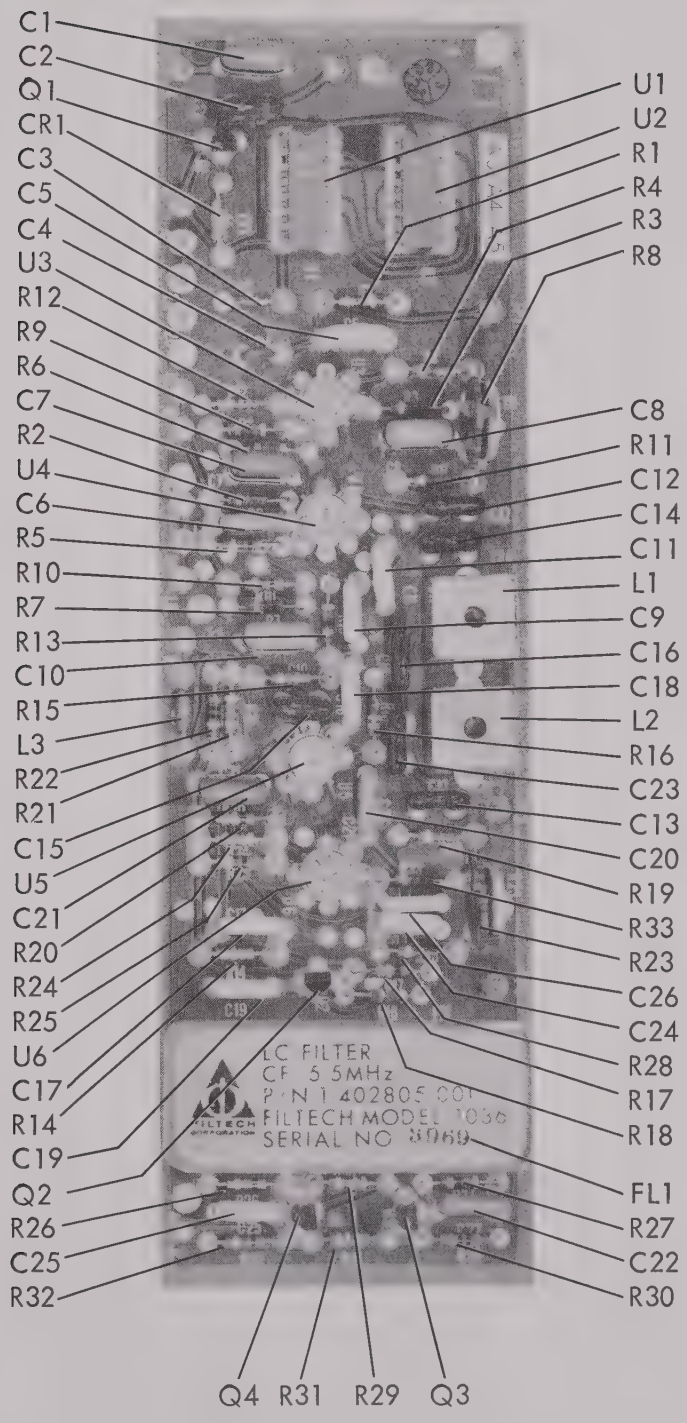


Figure 6-4. Parts Locations, Assemblies A3, A4 and A5

ASSEMBLIES A3, A4 & A5 1 KHz DECADE, 10 KHz DECADE, and 100 KHz DECADE

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C1	Capacitor .1 MF	1-900001-013	Amperex	280AE	3
C2	Capacitor 100 PF	1-900003-030	Electromotive	DM-15	3
C3 (BD A5 only)	Capacitor .1 MF	1-900001-013	Amperex	280ÁE	1
C4	Capacitor .001 MF	1-900012-002	Erie	86125U102P	3
C5	Capacitor .047 MF	1-900001-009	Amperex	Type 280AE	3
C6	Capacitor .01 MF	1-900001-001	Amperex	Type 280AE	3
C7,C8	Capacitor .1 MF	1-900001-013	Amperex	Type 280AE	6
C9	Capacitor .047 MF	1-900001-009	Amperex	Type 280AE	3
C10	Capacitor .1 MF	1-900001-013	Amperex	Type 280AE	3
C11	Capacitor .047 MF	1-900001-009	Amperex	Type 280AE	3
C12,C13	Capacitor 470 PF	1-900003-047	Electromotive	Type DM15	6
C14	Capacitor 180 PF	1-900003-034	Electromotive	Type DM15	3
C15	Capacitor 2 PF	1-900003-002	Electromotive	Type DM15	3
C16	Capacitor 200 PF	1-900003-037	Electromotive	Type DM15	3
C17,C18	Capacitor .047 MF	1-900001-009	Amperex	Type 280AE	6
C19	Capacitor 100 PF	1-900003-030	Electromotive	Type DM15	3
C20	Capacitor .047 PF	1-900001-009	Amperex	Type 280AE	3
C21	Capacitor .1 MF	1-900001-013	Amperex	Type 280AE	3
C22,C23	Capacitor .01 MF	1-900001-001	Amperex	Type 280AE	3
C24,-C26	Capacitor .047 MF	1-900001-009	Amperex	Type 280AE	9
CR1	Diode 1N273	1-913005-001	Transitron	1N273	3
FL1	Filter - Band Pass	1-402805-001			3
L1,L2	RF Coil	1-900006-006	Precision Coil	LR46	6
L3	Choke, RF 10 UF	1-906002-015	JW Miller	70F105A1	3
Q1-Q4	Transistor 2N3904	1-958000-001	Motorola	2N3904-5	12

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R1	Resistor 4.7 K	1-945000-045	Allen-Bradley	Type CB	3
R2	Resistor 150, Ω	1-945000-027	Allen-Bradley	Type CB	3
R3	Resistor 2.2 K	1-945000-041	Allen-Bradley	Type CB	3
R4	Resistor 1.5 K	1-945000-039	Allen-Bradley	Type CB	3
R5	Resistor 1 K	1-945000-037	Allen-Bradley	Type CB	3
R6	Resistor 470 Ω	1-945000-033	Allen-Bradley	Type CB	3
R7	Resistor 10 Ω	1-945000-013	Allen-Bradley	Type CB	3
R8	Resistor Variable 500 Ω	1-945007-003	Chicago Tel. Supply	Type X201	3
R9	Resistor 470 PF	1-945000-033	Allen-Bradley	Type CB	3
R10	Resistor 1 K	1-945000-037	Allen-Bradley	Type CB	3
R11	Resistor 1.5 K	1-945000-039	Allen-Bradley	Type CB	3
R12	Resistor 2.2 K	1-945000-041	Allen-Bradley	Type CB	3
R13	Resistor 10 Ω	1-945000-013	Allen-Bradley	Type CB	3
R14	Resistor 68 K	1-945000-059	Allen-Bradley	Type CB	3
R15	Resistor 560 Ω	1-945000-034	Allen-Bradley	Type CB	3
R16	Resistor 22 K	1-945000-053	Allen-Bradley	Type CB	3
R17	Resistor 10 K	1-945000-049	Allen-Bradley	Type CB	3
R18	Resistor 470 Ω	1-945000-033	Allen-Bradley	Type CB	3
R19	Resistor 22 K	1-945000-041	Allen-Bradley	Type CB	3
R20	Resistor 10 K	1-945000-049	Allen-Bradley	Type CB	3
R21	Resistor 470 Ω	1-945000-033	Allen-Bradley	Type CB	3
R22	Resistor 10 Ω	1-945000-013	Allen-Bradley	Type CB	3
R23	Resistor Variable 500 Ω	1-945007-003	Chicago Tel. Supply	Type X201	3
R24	Resistor 470 Ω	1-945000-033	Allen-Bradley	Type CB	3
R25	Resistor 1 K	1-945000-037	Allen-Bradley	Type CB	3

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R26	Resistor 100 Ω	1-945000-025	Allen-Bradley	Type CB	3
R27	Resistor 47 Ω	1-945000-021	Allen-Bradley	Type CB	3
R28	Resistor 2.2 K	1-945000-041	Allen-Bradley	Type CB	3
R29	Resistor 3.3 K	1-945000-043	Allen-Bradley	Type CB	3
R30	Resistor 10 Ω	1-945000-013	Allen-Bradley	Type CB	3
R31	Resistor 150 K	1-945000-063	Allen-Bradley	Type CB	3
R32	Resistor 1 K	1-945000-037	Allen-Bradley	Type CB	3
R33	Resistor 22 K	1-945000-041	Allen-Bradley	Type CB	3
U1,U2	Integrated Circuit LU322B	1-926021-001	Signetics Corp	LU322B	6
U3-U6	Integrated Circuit CA3028A	1-926005-001	RCA	CA3028A	12

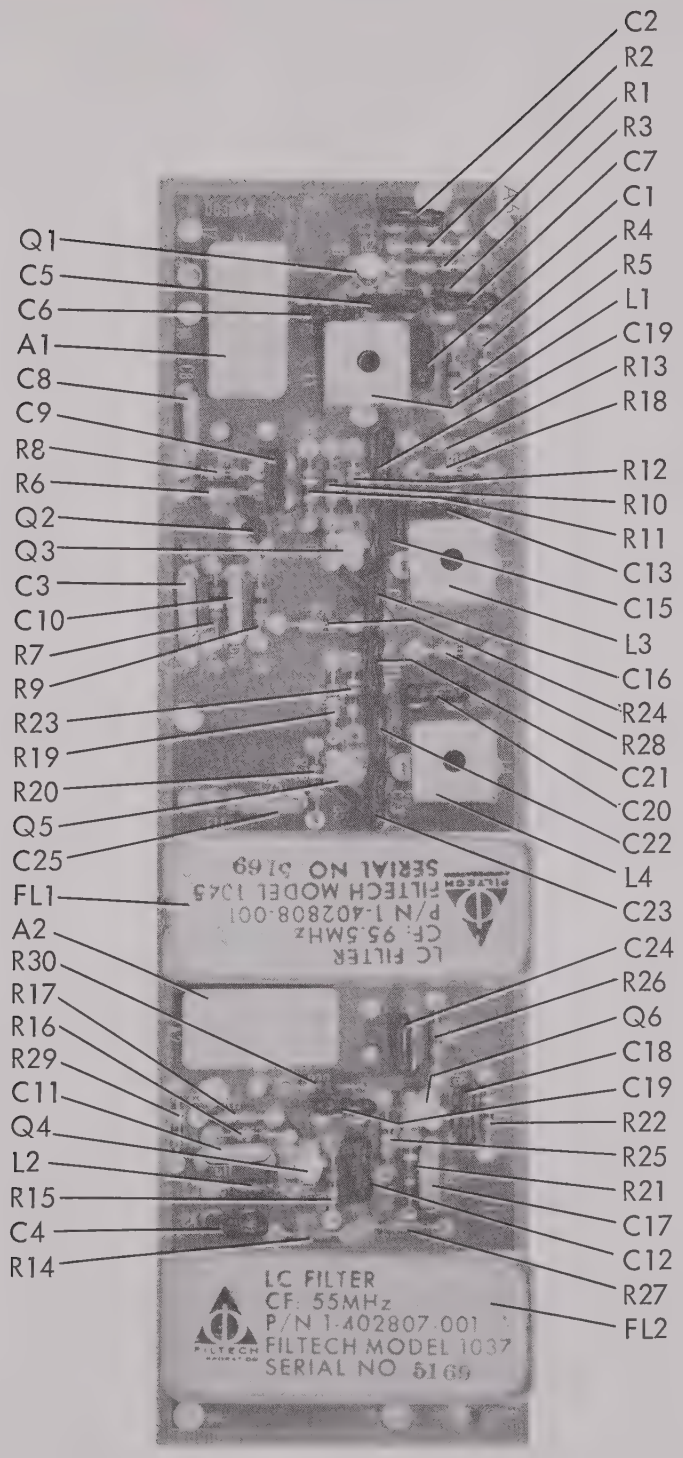


Figure 6-5. Parts Locations, Assembly A6

ASSEMBLY A6, 1 MHz DECADE

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
A1,A2	Mixer DBM-160A	1-919010-001			2
C1	Capacitor 1000 PF	1-900003-056	Vari-L Co.	DBM-160A	1
C2	Capacitor 150 PF	1-900003-034	Electro Motive Mfg.	DM 15	1
C3	Capacitor .01 UF	1-900001-001	Amperex Electro	C280AE	1
C4,C5	Capacitor 150 PF	1-900003-034	Electro Motive Mfg.	DM 15	2
C6	Capacitor 15 PF	1-900003-010	Electro Motive Mfg.	DM 15	1
C7	Capacitor 1000 PF	1-900003-056	Electro Motive Mfg.	DM 15	1
C8	Capacitor .01 UF	1-900001-001	Amperex	C280 AE	1
C9	Capacitor 150 PF	1-900003-034	Electro Motive Mfg.	DM15	1
C10,C11	Capacitor .01 UF	1-900001-001	Amperex	C280 AE	2
C12-C14	Capacitor 1000 PF	1-900003-056	Electro Motive Mfg.	DM15	3
C15	Capacitor 47 PF	1-900003-021	Electro Motive Mfg.	DM15	1
C16	Capacitor 15 PF	1-900003-010	Electro Motive Mfg.	DM 15	1
C17	Capacitor .01 UF	1-900001-001	Amperex	C280 AE	1
C18,C19	Capacitor 150 PF	1-900003-034	Electro Motive Mfg.	DM 15	2
C20,C21	Capacitor 1000 PF	1-900003-056	Electro Motive Mfg.	DM 15	2
C22	Capacitor 68 PF	1-900003-026	Electro Motive Mfg.	DM 15	1
C23	Capacitor 12 PF	1-900003-009	Electro Motive Mfg.	DM 15	1
C24	Capacitor 150 PF	1-900003-034	Electro Motive Mfg.	DM 15	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C25	Capacitor .01 UF	1-900001-001	Amperex	C280 AE	1
FL1	Filter 95-96 MHZ	1-90000-	1-402808-001		1
FL2	Filter 50-60 MHZ	1-402807-001			1
L1	Coil .16-.23 UH	1-906006-006	Precision Coil Co.	L57-6CTF4	1
L2	Coil .47 UH	1-906008-002	Wilco Corp.	H4-99848	1
L3,L4	Coil .16-.23 UH	1-906006-006	Precision Coil Co.	L57-6CTF4	2
Q1	Transistor 2N5179	1-958018-001	RCA	2N5179	1
Q2	Transistor 2N3904	1-958000-001	Motorola	2N3904-5	1
Q3-Q6	Transistor 2N5179	1-958018-001	RCA	2N5179	4
R1	Resistor, Carbon 10 K	1-945000-061	Allen-Bradley	Type CB	1
R2	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R3	Resistor, Carbon 10	1-945000-013	Allen-Bradley	Type CB	1
R4	Resistor, Carbon 330	1-945000-031	Allen-Bradley	Type CB	1
R5	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R6	Resistor, Carbon 270	1-945000-030	Allen-Bradley	Type CB	1
R7	Resistor, Carbon 100 K	1-945000-061	Allen-Bradley	Type CB	1
R8,R9	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	2
R10	Resistor, Carbon 10 K	1-945000-049	Allen-Bradley	Type CB	1
R11	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R12	Resistor, Carbon 33	1-945000-019	Allen-Bradley	Type CB	1
R13	Resistor, Carbon 330	1-945000-031	Allen-Bradley	Type CB	1
R14	Resistor, Carbon 180	1-945000-028	Allen-Bradley	Type CB	1
R15	Resistor, Carbon 27	1-945000-018	Allen-Bradley	Type CB	1
R16	Resistor, Carbon 10 K	1-945000-049	Allen-Bradley	Type CB	1
R17	Resistor, Carbon 1.8 K	1-945000-040	Allen-Bradley	Type CB	1
R18	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R19	Resistor, Carbon 10 K	1-945000-049	Allen-Bradley	Type CB	1
R20	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R21	Resistor, Carbon 470	1-945000-033	Allen-Bradley	Type CB	1
R22,R23	Resistor, Carbon 33	1-945000-019	Allen-Bradley	Type CB	2
R24	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R25	Resistor, Carbon 10 K	1-945000-049	Allen-Bradley	Type CB	1
R26	Resistor, Carbon 1.8 K	1-945000-040	Allen-Bradley	Type CB	1
R27	Resistor, Carbon 180	1-945000-028	Allen-Bradley	Type CB	1
R28	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R29	Resistor, Carbon 47	1-945000-021	Allen-Bradley	Type CB	1
R30	Resistor, Carbon 330	1-945000-031	Allen-Bradley	Type CB	1

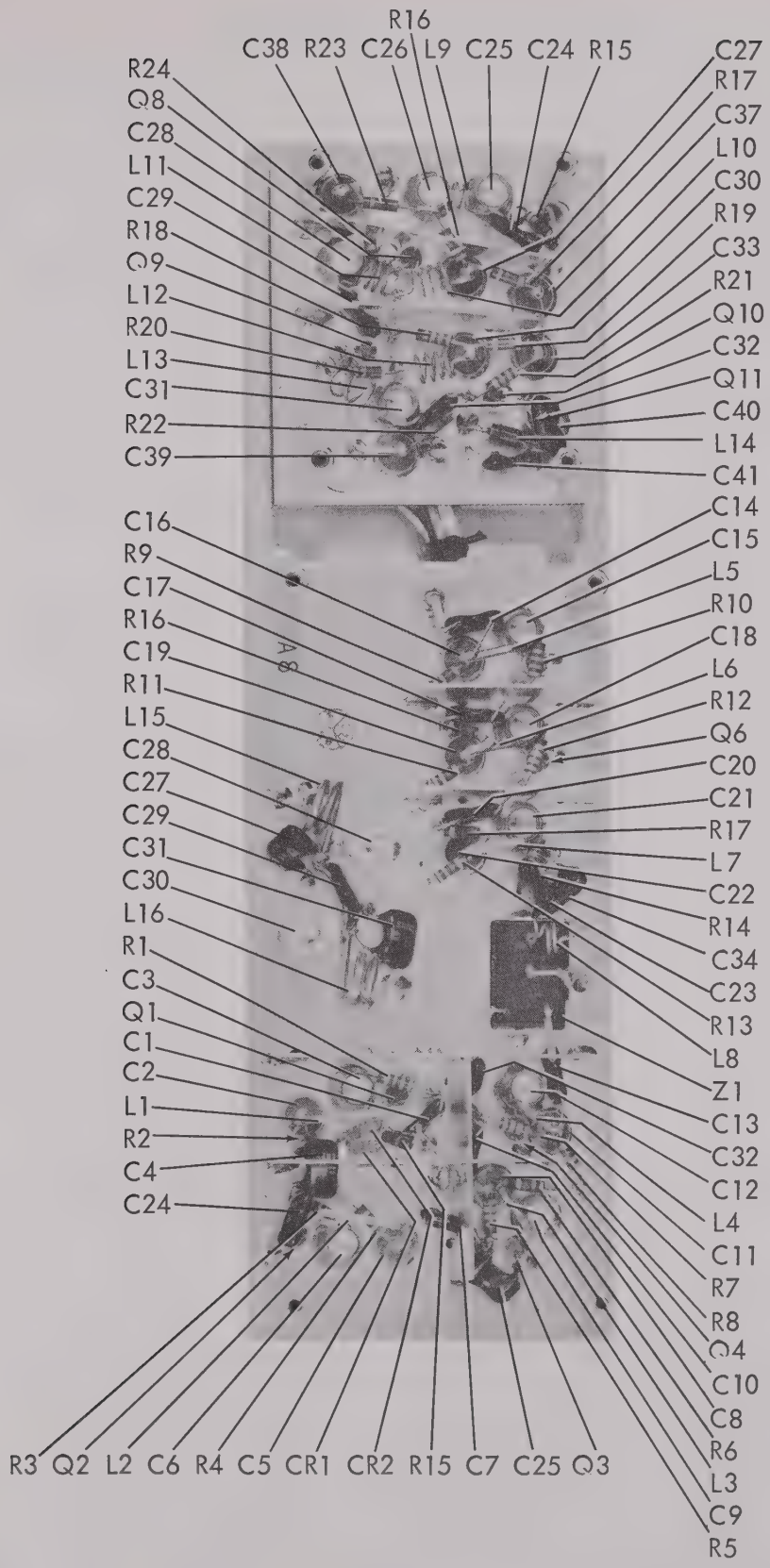


Figure 6-6. Parts Locations, Assemblies A7, A8

ASSEMBLY A7, GAIN CONTROL AMPLIFIER

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C24	Capacitor 47 PF	1-90003-021	Electromotive Mfg.	DM15	1
C25,C26	Capacitor Trim 1-12 PF	1-900063-001	Johanson Mfg	H4-91293/ 7341-A	2
C27	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	H4-01121- SS5D-471W	1
C28	Capacitor Trim 1-12 PF	1-900063-001	Johanson Mfg	H4-91293/ 7341-A	1
C29	Capacitor 47 PF	1-90003-021	Electromotive Mfg.	DM15	1
C30,C31	Capacitor Trim 1-12 PF	1-900063-001	Johanson Mfg	H4-91293/ 7341-A	2
C32	Capacitor 47 PF	1-90003-021	Electromotive Mfg.	DM15	1
C33	Capacitor Feed Thru 470 PF	1-900045-001	Allen-Bradley	H4-01121, FASC	1
C37	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	H4-01121/ SSSD-471W	1
C38	Capacitor Trim 1-12 PF	1-900063-001	Johanson Mfg	H491293/ 7341-A	1
C39	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	H4-01121/ SS5D-471W	1
C40	Capacitor 2 PF	1-900003-002	Electromotive Mfg	DM15	1
C41	Capacitor 470 PF	1-900003-047	Electromotive Mfg	DM15	1
L9	Coil 2T	1-402953-001	–	–	1
L10	Coil 4T	1-402953-003	–	–	1
L11	Coil 3T	1-402953-002	–	–	1
L12	Coil 4T	1-402953-003	–	–	1
L13	Coil 3T	1-402953-002	–	–	1
L14	Coil RF, 47 UH	1-906008-002	Wilco Corp	H4-99848	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
Q8	Transistor 2N5179	1-958018-001	RCA	2N5179	1
Q9	Transistor 2N5179	1-958018-001	RCA	2N5179	1
Q10	Transistor 2N5179	1-958018-001	RCA	2N5179	1
Q11	Transistor 2N5179	1-958018-001	RCA	2N5179	1
R15	Resistor 47 Ω	1-945000-021	Allen-Bradley	CB-H4-01121	1
R16	Resistor 39 K	1-945000-56	Allen-Bradley	CB-H4-01121	1
R17	Resistor 820	1-945000-036	Allen-Bradley	CB-H4-01121	1
R18	Resistor 33 K	1-945000-055	Allen-Bradley	CB-H4-01121	1
R19	Resistor 470	1-945000-033	Allen-Bradley	CB-H4-01121	1
R20	Resistor 2.7 Ω	1-945000-006	Allen-Bradley	CB H4-01121	1
R21	Resistor 33 K	1-945000-055	Allen-Bradley	CB H4-01121	1
R22	Resistor 100 Ω	1-945000-025	Allen-Bradley	CB H4-01121	1
R23,R24	Resistor 8.2 K	1-945000-048	Allen-Bradley	CB H4-01121	2

ASSEMBLY A8, 10 MHz DECADE

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C1	Capacitor 22 PF	1-900003-013	Electromotive Mfg	DM15	1
C2	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	SS5D-471W	1
C3	Capacitor Variable	1-900063-001	Johanson Mfg	7341-A	1
C4	Capacitor 10 PF	1-900003-008	Electromotive Mfg	DM15	1
C5	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	SS5D-471W	1
C6	Capacitor Variable	1-900063-001	Johanson Mfg	7341-A	1
C7	Capacitor 10 PF	1-900003-008	Electromotive Mfg	DM15	1
C8	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	SS5D-471W	1
C9	Capacitor Variable	1-900063-001	Johanson Mfg	7341-A	1
C10	Capacitor 3 PF	1-900003-003	Electromotive Mfg	DM15	–
C11	Capacitor Standoff 470 PF	1-900044-001	Allen Bradley	SS5D-471W	1
C12	Capacitor Variable	1-900063-001	Johanson Mfg	7341-A	1
C13	Capacitor 3 PF	1-900003-003	Electromotive Mfg	DM15	1
C14	Capacitor 10 PF	1-900003-008	Electromotive Mfg	DM15	1
C15	Capacitor Variable	1-900063-001	Johanson Mfg	7341-A	1
C16	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	SS5D-471W	1
C17	Capacitor 10 PF	1-900003-008	Electromotive Mfg	DM15	1
C18	Capacitor Variable	1-900063-001	Johanson Mfg	7341-A	1
C19	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	SS5D-471W	1
C20	Capacitor 10 PF	1-900003-008	Electromotive Mfg	DM-15	
C21	Capacitor Variable	1-900063-001	Johanson Mfg	7341-A	
C22	Capacitor Standoff 470 PF	1-900044-001	Allen-Bradley	SS5D-471W	

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C23,C24	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	
C25	Capacitor 5 PF	1-900003-004	Electromotive	DM-15	
C26					
C27	Capacitor 120 PF	1-900003-032	Electromotive	DM-15	
C28	Capacitor Trim 2-16 PF	1-900065-001	E.F.Johnson Co.	187-106-5	1
C29	Capacitor 5 PF	1-900003-004	Electromotive	DM-15	1
C30	Capacitor Trim 2-16 PF	1-900065-001	E.F.Johnson Co.	187-106-5	1
C31	Capacitor 120 PF	1-900003-032	Electromotive	DM15	1
C32,C33	Capacitor 2 PF	1-900003-002	Electromotive	DM15	2
C34	Capacitor 3 PF	1-900003-003	Electromotive	DM15	1
CR1,2	Diode 1N273	1-913005-001	Transitron Electronic Corp	—	2
L1	Inductor No. 14	1-201741-001			1
L2	Inductor No. 16	1-201740-001			1
L3-7	Inductor No. 14	1-201741-001			5
L8	Coil 2T	1-402953-001	Gertsch		1
L15,L16	Coil 2T 3001D	1-403042-001	Gertsch		2
Q1-7	Transistor 2N5179	1-958018-001	RCA	2N5179	7
R1	Resistor 33 K	1-945000-055	Allen-Bradley	Type CB	1
R2	Resistor 330	1-945000-031	Allen-Bradley	Type CB	1
R3	Resistor 33 K	1-945000-055	Allen-Bradley	Type CB	1
R4	Resistor 330	1-945000-031	Allen-Bradley	Type CB	1
R5	Resistor 33 K	1-945000-055	Allen-Bradley	Type CB	1
R6	Resistor 330	1-945000-031	Allen-Bradley	Type CB	1
R7	Resistor 33 K	1-945000-055	Allen-Bradley	Type CB	1
R8	Resistor 330	1-945000-031	Allen-Bradley	Type CB	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R9	Feed Thru Terminal	1-941000-001	Garlock Elec Prod	Type 69001-001	1
R10	Resistor 33 K	1-945000-055	Allen-Bradley	Type CB	1
R11	Feed Thru Terminal	1-941000-001	Garlock Elec Prod	Type 69001-001	1
R12	Resistor 33 K	1-945000-005	Allen-Bradley	Type CB	1
R13	Feed Thru Terminal	1-941000-001	Garlock Elec Prod	69001-0800	1
R14	Resistor 33 K	1-945000-005	Allen-Bradley	Type CB	1
R15	Resistor 27 Ω	1-945000-018	Allen-Bradley	Type CB	1
R16	Resistor 15 Ω	1-945000-015	Allen-Bradley	Type CB	1
R17	Resistor 10 Ω	1-945000-013	Allen-Bradley	Type CB	1
Z1	M8E	1-919012-001	RELCOM	M8E	1

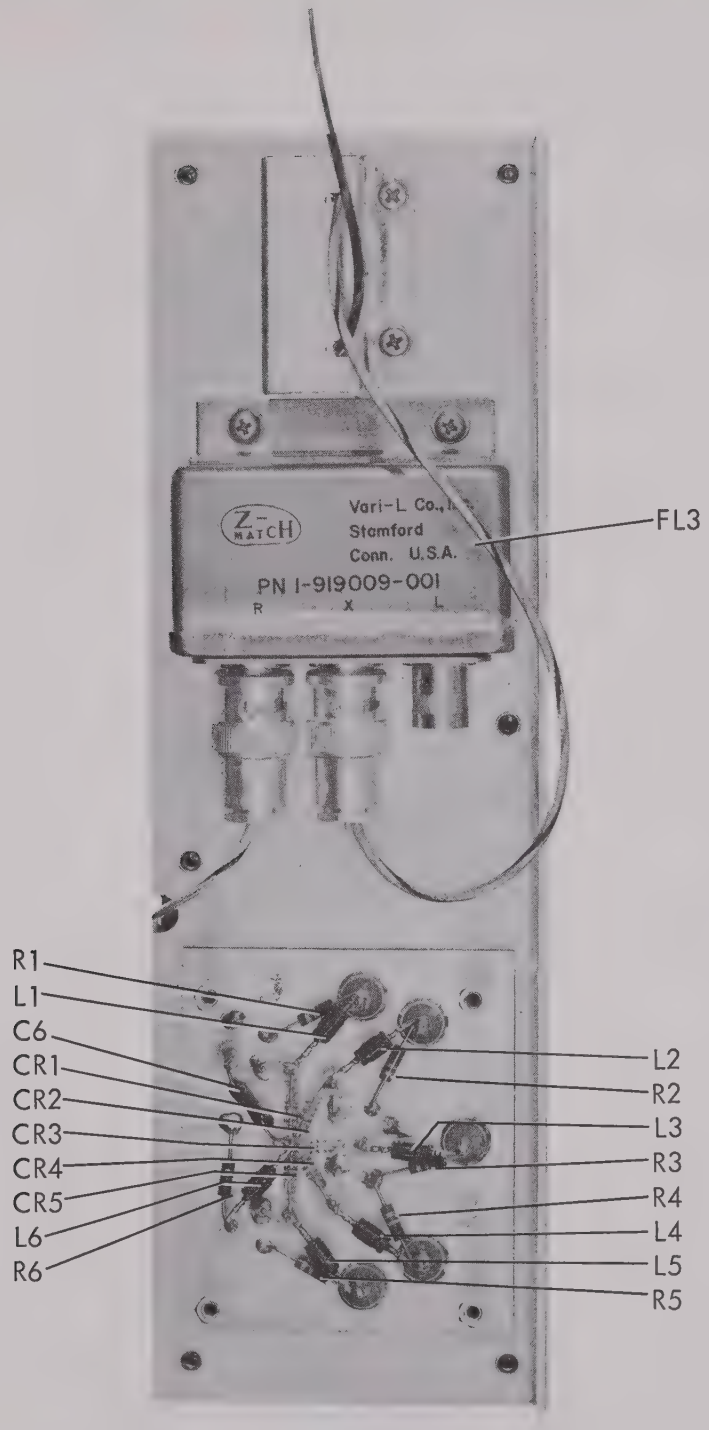


Figure 6-7. Parts Locations, Assembly A9

ASSEMBLY A9, DIODE SWITCH, MIXER, LOW PASS FILTER

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C1-C5	Capacitor 470 PF	1-900045-001	Allen-Bradley	H4-01121/ FA5C	5
C6	Capacitor 5 PF	1-900003-004	Electromotive Mfg	DM-15	1
CR1-CR5	Diode 1N 273	1-913005-001	Transitron	1N273	5
L1-L6	Choke 0.47 UH	1-906008-002	Wilco Corp	H4-99848	6
R1-R5	Resistor	1-945000-053	Allen Bradley	CB-H4-01121	5
R6	Resistor 270 Ω	1-945000-030	Allen-Bradley	CB-H401121	1

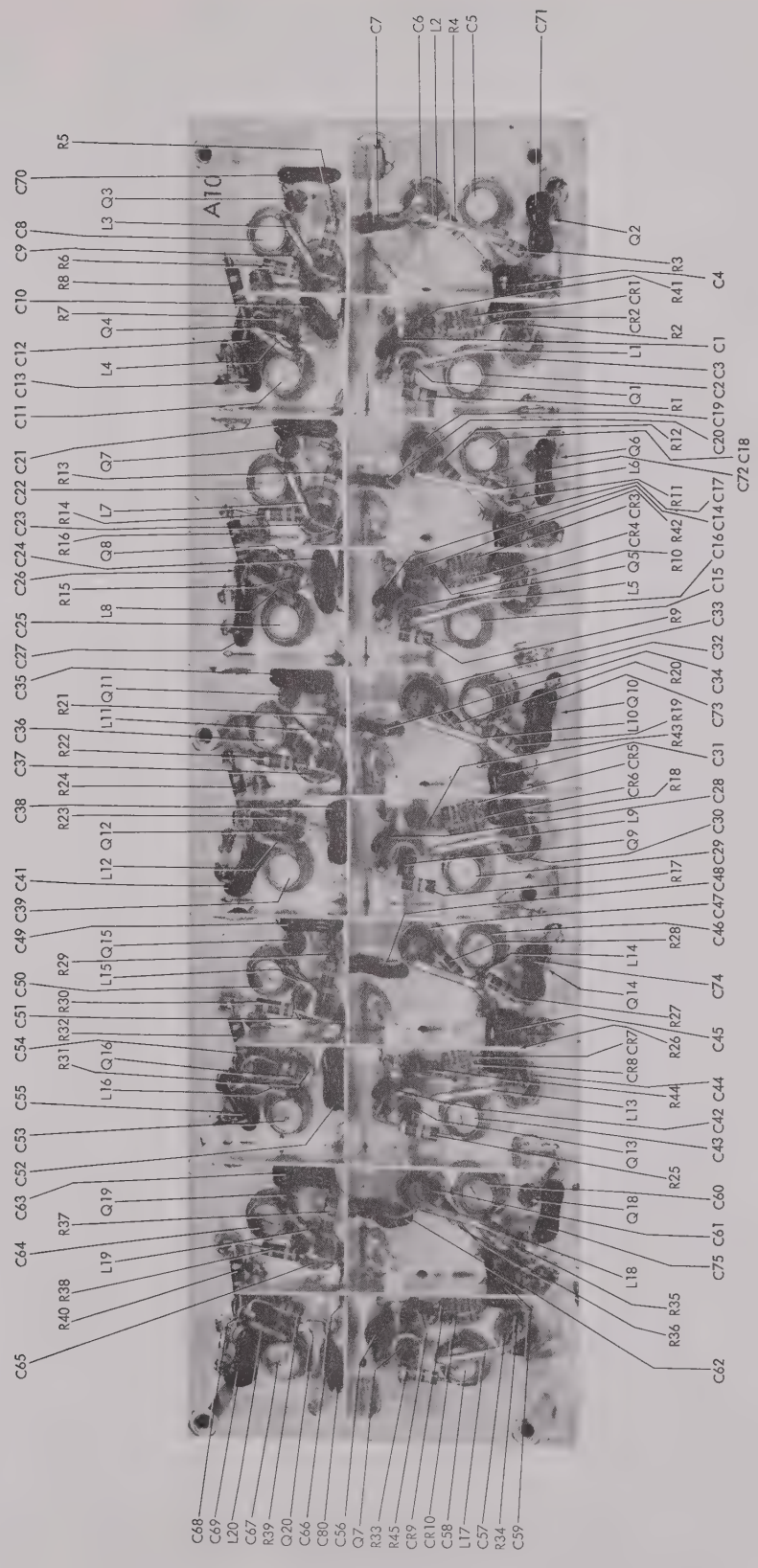


Figure 6-8. Parts Locations, Assembly A10

ASSEMBLY A10, 100 MHz DECADE

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C1	Capacitor 22 PF	1-900003-013	Electro-Motive Mfg	DM-15	1
C2	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C3	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C4	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	1
C5	Capacitor Variable	1-9000063-001	Johanson	7341-A	1
C6	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C7	Capacitor 10 PF	1-900003-008	Electromotive	DM15	1
C8	Capacitor Variable	1 900063-001	Johanson	7341-A	1
C9?	Capacitor 470 PF	1-900003-047	Electromotive	DM15	1
C10	Capacitor 3 PF	1-900003-003	Electromotive	DM15	1
C11	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C12	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C13	Capacitor 5 PF	1-900003-004	Electromotive	DM15	1
C14	Capacitor 22 PF	1-900003-013	Electromotive	DM-15	1
C15	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C16	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C17	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	1
C18	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C19	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C20	Capacitor 3 PF	1-900003-003	Electromotive	DM15	1
C21	Capacitor 5 PF	1-900003-004	Electromotive	DM-15	1
C22	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C23	Capacitor 3 PF	1-900003-003	Electromotive	DM-15	1
C24	Capacitor 3 PF	1-900003-003	Electromotive	DM-15	1
C25	Capacitor Variable	1-900063-001	Johanson	7341-A	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C26	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C27	Capacitor 5 PF	1-900003-004	Electromotive	DM-15	1
C28	Capacitor 22 PF	1-900003-013	Electromotive	DM-15	1
C29	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C30	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C31	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	1
C32	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C33	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C34	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	1
C35	Capacitor 2 PF Selected	1-900003-002	Electromotive	DM-15	1
C36	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C37	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C38	Capacitor 3 PF	1-900003-003	Electromotive	DM-15	1
C39	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C40	Capacitor 470 PF	1-900003-047	Electromotive	DM-15	1
C41	Capacitor 5 PF	1-900003-004	Electromotive	DM-15	1
C42	Capacitor 22 PF	1-900003-013	Electromotive	DM-15	1
C43	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C44	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C45	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	1
C46	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C47	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C48	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	1
C49	Capacitor 2 PF Selected	1-900003-002	Electromotive	DM-15	1
C50	Capacitor Variable	1-900063-001	Johanson	7341-A	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C51	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C52	Capacitor 3 PF	1-900003-003	Electromotive	DM-15	1
C53	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C54	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C55	Capacitor 5 PF	1-900003-004	Electromotive	DM15	1
C56	Capacitor 22 PF	1-900003-013	Electromotive	DM-15	1
C57	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C58	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C59	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	1
C60	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C61	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C62	Capacitor 10 PF	1-900003-008	Electromotive	DM-15	1
C63	Capacitor 2 PF Selected	1-900003-002	Electromotive	DM-15	1
C64	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C65	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C66	Capacitor 3 PF	1-900003-003	Electromotive	DM15	1
C67	Capacitor Variable	1-900063-001	Johanson	7341-A	1
C68	Capacitor Standoff	1-900044-001	Allen-Bradley	SS5D-471W	1
C69-C72	Capacitor 5 PF	1-900003-004	Electromotive	DM15	1
C73-C78	Capacitor 2 PF Selected	1-900003-002	Electromotive	DM15	1
C79,80	Capacitor 1 PF	1-900003-001	Electromotive	DM-15	1
CR1-CR10	Diode 1N273	1-913005-001	Transitron	H4-03877	10
L1,L2	Inductor # 16	1-201740-001			2
L3,L4	Inductor # 14	1-201741-001			2
L5,L6	Inductor # 16	1-201740-001			2
L7,L8	Inductor # 14	1-201741-001			2

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
L9,L10	Inductor #14	1-201738-001			2
L11,L12	Inductor #14	1-201739-001			2
L13,L14	Inductor #14	1-201738-001			2
L15,L16	Inductor #14	1-201739-001			2
L17,L18	Inductor #14	1-201738-001			2
L19,L20	Inductor #14	1-201739-001			2
Q1-Q20	Transistor 2N5179	1-958018-001	RCA	2N5179	20
R1	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R2	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R3	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R4	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R5	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R6	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R7	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R8	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R9	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R10	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R11	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R12	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R13	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R14	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R15	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R16	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R17	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R18	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R19	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R20	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R21	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R22	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R23	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R24	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R25	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R26	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R27	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R28	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R29	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R30	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R31	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R32	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R33	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R34	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R35	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R36	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R37	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R38	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R39	Resistor 47 K	1-945000-057	Allen-Bradley	CB H4-01121	1
R40	Resistor 330 Ω	1-945000-031	Allen-Bradley	CB H4-01121	1
R41-R45	Resistor 27 Ω	1-945000-018	Allen-Bradley	CB H4-01121	5

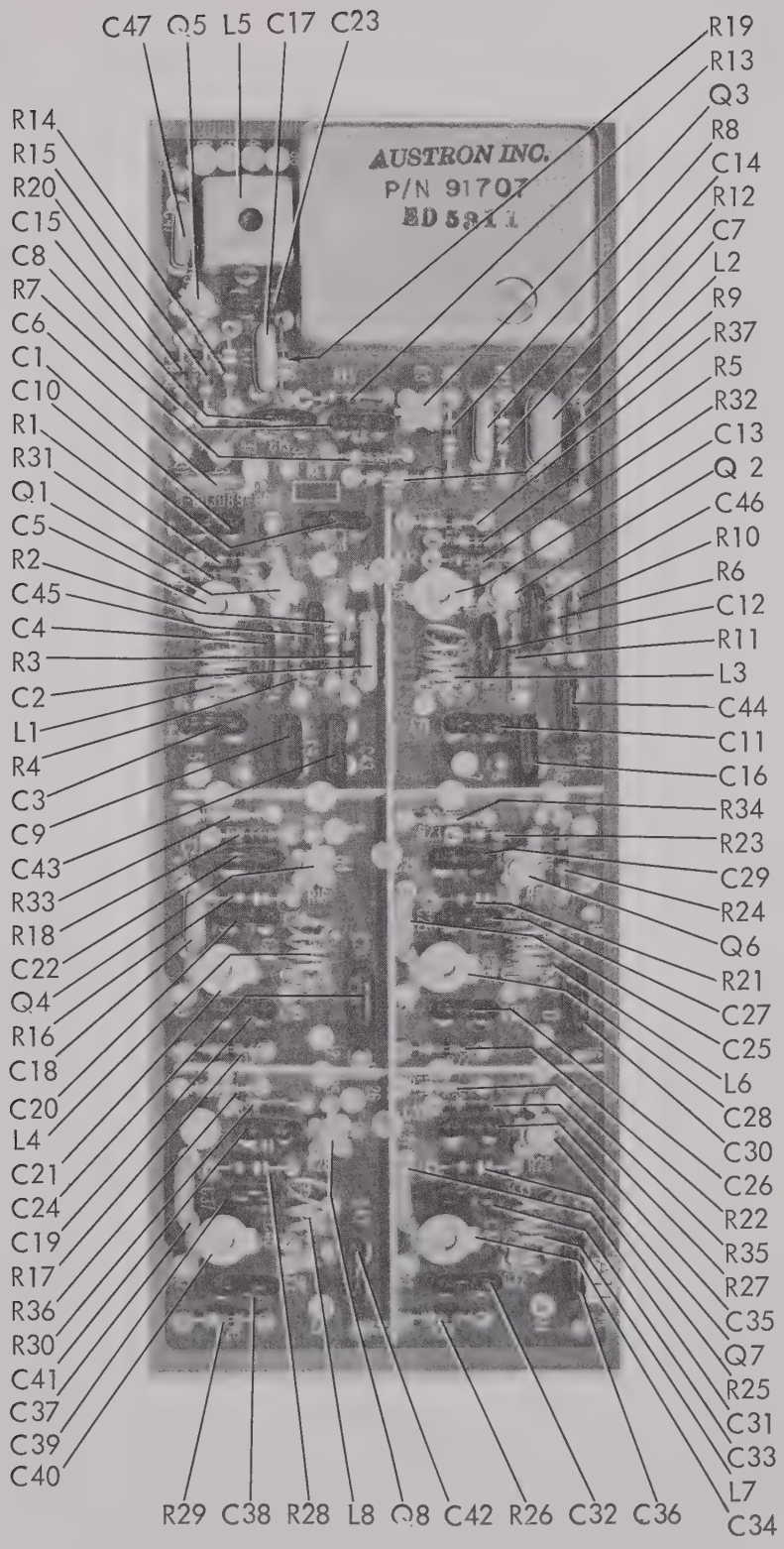


Figure 6-9. Parts Locations, Assembly A11

ASSEMBLY A11, TCXO BUFFER AMPLIFIER

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
A1	TCXO 1 x 10^{-7}	1-403095-001	Gerish	1-403095-001	1
A1	TCXO 10 MHZ	1-402838-003	Austron Inc	Type TXCO-52 P/N 91707	1
C1	Capacitor, Var 470 PF	1-900003-047	Electromotive	Type DM15	1
C2	Capacitor, Var .01 UF	1-900001-001	Amperex	Type C280AE	1
C3	Capacitor, Var 1000 PF	1-900003-056	Electromotive	Type DM15	1
C4	Capacitor, Var 43 PF	1-900003-020	Electromotive	Type DM15	1
C5	Capacitor, Var 1.7-11 PF	1-900065-001	E.F.Johnson Co.	187-106-5	1
C6	Capacitor, Var .022 UF	1-900001-005	Amperex	Type C280AE	1
C7	Capacitor, Var .1 UF	1-900001-013	Amperex	Type C280AE	1
C8	Capacitor, Var 33 PF	1-900003-017	Electromotive	Type DM15	1
C9,C10	Capacitor, Var 470 PF	1-900003-047	Electromotive	Type DM15	2
C11	Capacitor, Var 1000 PF	1-900003-056	Electromotive	Type DM15	1
C12	Capacitor, Var 43 PF	1-900003-020	Electromotive	Type DM15	1
C13	Capacitor, Var 1.7-11 PF	1-900065-001	E.F.Johnson Co	187-106-5	1
C14	Capacitor, Var .01 UF	1-900001-001	Amperex	Type C280AE	1
C15,C16	Capacitor, Var 470 PF	1-900003-047	Electromotive	Type DM15	2
C17,C18	Capacitor, Var .01 UF	1-900001-001	Amperex	Type C280AE	1
C19	Capacitor, Var 1000 PF	1-900003-056	Electromotive	Type DM15	1
C20	Capacitor, Var 27 PF	1-900003-015	Electromotive	Type DM15	1
C21	Capacitor, Var 1.7-11 PF	1-900065-001	E.F.Johnson Co.	187-106-5	1
C22	Capacitor, Var 470 PF	1-900003-047	Electromotive	Type DM15	1
C23	Capacitor, Var 18 PF	1-900003-011	Electromotive	Type DM15	1
C24	Capacitor, Var 470 PF	1-900003-047	Electromotive	Type DM15	1
C25	Capacitor, Var .01 UF	1-900001-001	Amperex	Type C280AE	1
C26	Capacitor, Var 1000 PF	1-900003-056	Electromotive	Type DM15	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
C27	Capacitor, Var 15 PF	1-900003-010	Electromotive	Type DM15	1
C28	Capacitor, Var 1.7-11 PF	1-900065-001	E.F.Johnson Co.	187-106-5	1
C29,C30	Capacitor, Var 470 PF	1-900003-047	Electromotive	Type DM15	2
C31	Capacitor, Var .01 UF	1-900001-001	Amperex	Type C280AE	1
C32	Capacitor, Var 1000 PF	1-900003-056	Electromotive	Type DM15	1
C33	Capacitor, Var 15 PF	1-900003-010	Electromotive	Type DM15	1
C34	Capacitor, Var 1.7-11 PF	1-900065-001	E.F.Johnson Co	187-106-5	1
C35,C36	Capacitor, Var 470 PF	1-900003-047	Electromotive	Type DM15	2
C37	Capacitor, Var .01 UF	1-900001-001	Amperex	Type C280AE	1
C38	Capacitor, Var 1000 PF	1-900003-056	Electromotive	Type DM15	1
C39	Capacitor, Var 15 PF	1-900003-010	Electromotive	Type DM15	1
C40	Capacitor, Var 1.7-11 PF	1-900065-001	E.F.Johnson Co	187-106-5	1
C41-C44	Capacitor, Var 470 PF	1-900003-047	Electromotive	Type DM15	4
C45,C46	Capacitor, Var 1000 PF	1-900003-056	Electromotive	Type DM15	2
C47	Capacitor, Var .01 UF	1-900001-001	Amperex	Type C280AE	1
L1	Coil 1/4 ID 4.5T	1-402965-002	Gertsch	1-402965-002	1
L2	Choke 2.5 MH	1-906002-054	J.W.Miller Co.	70F253A1	1
L3,L4	Coil 1/4 ID 4.5T	1-402965-002	Gertsch	1-402965-002	2
L5	Coil LR24	1-906006-004	Precision Coil	LR24	1
L6,L7	Coil 1/4 ID 4.5T	1-402965-002	Gertsch	1-402965-002	2
L8	Coil 1/4 ID 3.5T	1-402965-003	Gertsch	1-402965-002	1
Q1-Q8	Transistor 2N5179	1-958018-001	RCA	2N5179	8
R1	Resistor, Carbon 10	1-945000-013	Allen-Bradley	Type CB	1
R2	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R3,R4	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	2
R5	Resistor, Carbon 10	1-945000-013	Allen-Bradley	Type CB	1

REF DESIG	DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
R6	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R7	Transistor, Carbon 2.2 K	1-945000-041	Allen-Bradley	Type CB	1
R8	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R9	Resistor, Carbon 3.3 K	1-945000-043	Allen Bradley	Type CB	1
R10,R11	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	2
R12	Resistor, Carbon 470	1-945000-033	Allen-Bradley	Type CB	1
R13	Resistor, Carbon 47	1-945000-021	Allen-Bradley	Type CB	1
R14	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R15	Resistor, Carbon 1.2 K	1-945000-038	Allen-Bradley	Type CB	1
R16	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R17	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R18	Resistor, Carbon 22 Ω	1-945000-017	Allen-Bradley	Type CB	1
R19,R20	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	2
R21	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R22	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R23	Resistor, Carbon 22 Ω	1-945000-017	Allen-Bradley	Type CB	1
R24	Resistor, Carbon 10	1-945000-013	Allen-Bradley	Type CB	1
R25	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R26	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R27	Resistor, Carbon 22 Ω	1-945000-017	Allen-Bradley	Type CB	1
R28	Resistor, Carbon 3.9 K	1-945000-044	Allen-Bradley	Type CB	1
R29	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1
R30	Resistor, Carbon 22 Ω	1-945000-017	Allen-Bradley	Type CB	1
R31,R32	Resistor, Carbon 1.2 K	1-945000-038	Allen-Bradley	Type CB	2
R33-R36	Resistor, Carbon 560 Ω	1-945000-034	Allen-Bradley	Type CB	4
R37	Resistor, Carbon 100	1-945000-025	Allen-Bradley	Type CB	1

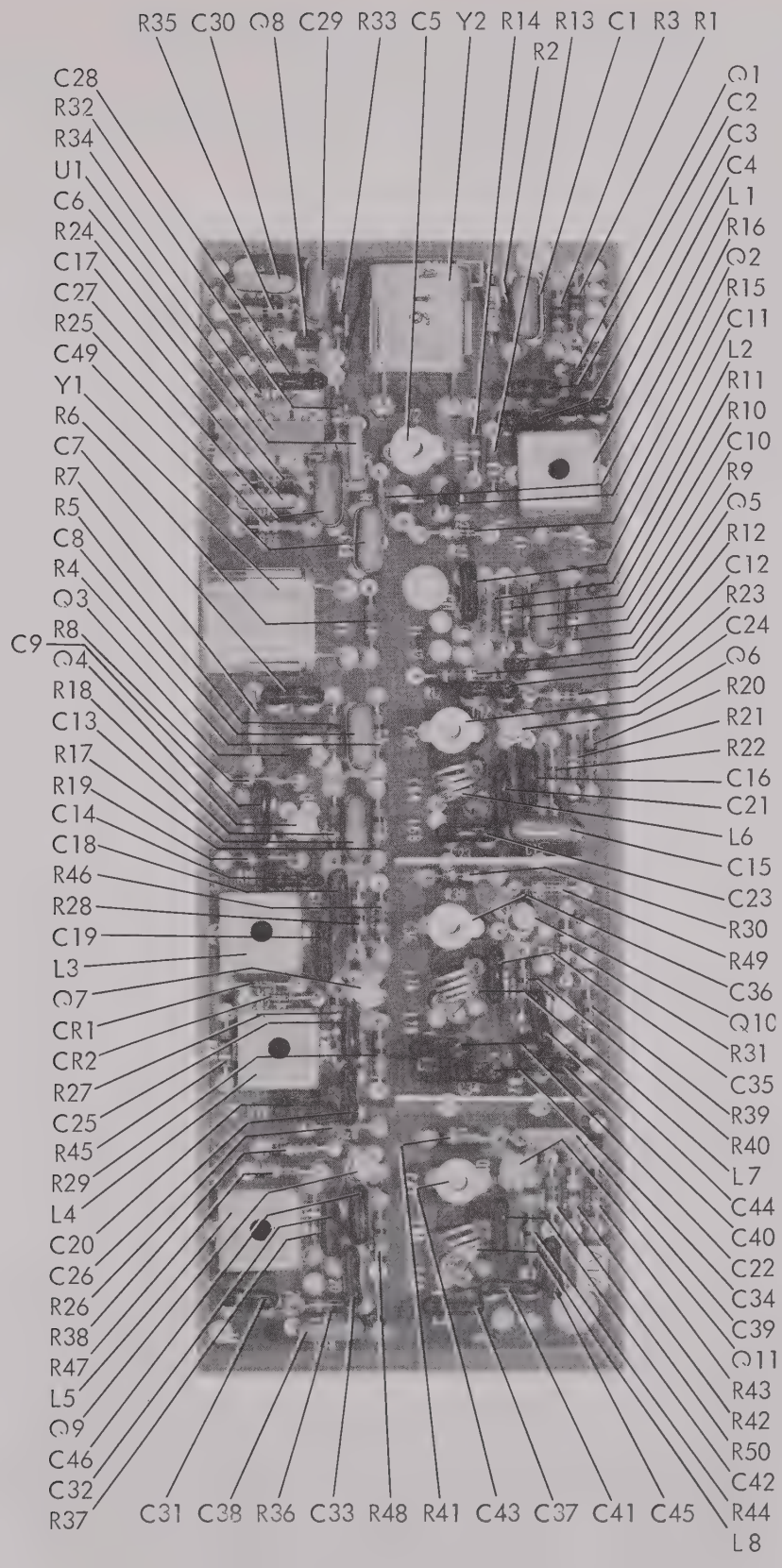


Figure 6-10. Parts Locations, Assemblies A12 to A21

REF DESIG		DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
	On Boards					
C1	A12-A21	Capacitor .1	1-900001-013	Amperex	Type C280AE	10
C2/C3	A12-A21	Capacitor 22 PF	1-900003-013	Electromotive	Type DM15	20
C4	A12-A21	Capacitor 10 PF	1-900003-008	Electromotive	Type DM15	10
C5	A12-A21	Capacitor 1.7-11 PF	1-900065-001	E.F.Johnson Co.	187-106-5	10
C6	A12-A21	Capacitor .01	1-900001-001	Amperex	Type C280AE	10
C7	A12-A21	Capacitor 470 PF	1-900003-056	Electromotive	Type DM15	10
C8	A12-A21	Capacitor .1	1-900001-013	Amperex	Type C280AE	10
C9	A12-A21	Capacitor 43 PF	1-900003-056	Electromotive	Type DM15	10
C10	A12-A21	Capacitor .1	1-900001-013	Amperex	Type C280AE	10
C11	A12-A21	Capacitor 24 PF	1-900003-013	Electromotive	Type DM15	10
C12	A12-A21	Capacitor 12 PF	1-900003-009	Electromotive	Type DM15	10
C13	A12-A21	Capacitor .02	1-900001-005	Amperex	Type C280AE	10
C14	A12-A21	Capacitor 10 PF	1-900003-008	Electromotive	Type DM15	10
C15	A12-A21	Capacitor .1	1-900001-013	Amperex	Type C280AE	10
C16	A12-A15	Capacitor 2 PF	1-900003-002	Electromotive	Type DM15	4
	A16-A21	Capacitor 5 PF	1-900003-004	Electromotive	Type DM15	6
C17	A12-A21	Capacitor .01	1-900001-001	Amperex	Type C280AE	10
C18	A12-A14	Capacitor 82 PF	1-900003-028	Electromotive	Type DM15	3
	A15	Capacitor 91 PF	1-900003-011	Electromotive	Type DM15	1
	A16-A21	Capacitor 68 PF	1-900003-026	Electromotive	Type DM15	6
C19	A12-A19	Capacitor 470 PF	1-900003-047	Electromotive	Type DM15	8
	A20,A21	Capacitor 680 PF	1-900003-052	Electromotive	Type DM15	2
C20	A12-A21	Capacitor 1000 PF	1-900003-056	Electromotive	Type DM15	10
C21	A12	Capacitor 10 PF	1-900003-008	Electromotive	Type DM15	1
	A13	Capacitor 15 PF	1-900003-010	Electromotive	Type DM15	1

REF DESIG		DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
	On Boards					
C21	A14	Capacitor 18 PF	1-900003-011	Electromotive	Type DM15	1
	A15-A17	Capacitor 24 PF	1-900003-014	Electromotive	Type DM15	3
	A18	Capacitor 33 PF	1-900003-017	Electromotive	Type DM15	1
	A19	Capacitor 43 PF	1-900003-020	Electromotive	Type DM15	1
	A20,A21	Capacitor 56 PF	1-900003-024	Electromotive	Type DM15	2
C22	A12-A21	Capacitor 1000 PF	1-900003-056	Electromotive	Type DM15	10
C23	A12-A21	Capacitor 470 PF	1-900003-047	Electromotive	Type DM15	10
C24	A12-A21	Capacitor 1.7-11 PF	1-900065-001	E.F.Johnson Co.	187-106-5	10
C25	A12-A14	Capacitor 82 PF	1-900003-028	Electromotive	Type DM15	3
	A15	Capacitor 91 PF	1-900003-029	Electromotive	Type DM15	1
	A16-A21	Capacitor 68 PF	1-900003-026	Electromotive	Type DM15	6
C26	A12-A18	Capacitor 470 PF	1-900003-047	Electromotive	Type DM15	7
	A19-A21	Capacitor 680 PF	1-900003-052	Electromotive	Type DM15	3
C27	A12-A21	Capacitor 0.1	1-900001-013	Amperex	Type C280AE	10
C28	A12-A18	Capacitor 15 PF	1-900003-010	Electromotive	Type DM15	7
	A19	Capacitor 12 PF	1-900003-009	Electromotive	Type DM15	1
	A20,A21	Capacitor 15 PF	1-900003-010	Electromotive	Type DM15	2
C29	A12-A21	Capacitor 0.1	1-900001-013	Amperex	Type C280AE	10
C30	A12-A21	Capacitor .01	1-900001-001	Amperex	Type C280AE	10
C31	A12-A21	Capacitor 1000 PF	1-900003-056	Electromotive	Type DM15	10
C32	A12-A14	Capacitor 82 PF	1-900003-028	Electromotive	Type DM15	3
	A15	Capacitor 91 PF	1-900003-029	Electromotive	Type DM15	1
	A16-A21	Capacitor 68 PF	1-900003-026	Electromotive	Type DM15	6
C33	A12-A19	Capacitor 470 PF	1-900003-047	Electromotive	Type DM15	8
	A20,A21	Capacitor 680 PF	1-900003-052	Electromotive	Type DM15	2

REF DESIG		DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
	On Boards					
C34	A12-A21	Capacitor 470 PF	1-900003-047	Electromotive	Type DM15	10
C35	A12	Capacitor 10 PF	1-900003-008	Electromotive	Type DM15	1
	A13	Capacitor 15 PF	1-900003-010	Electromotive	Type DM15	1
	A14	Capacitor 18 PF	1-900003-011	Electromotive	Type DM15	1
	A15-A17	Capacitor 24 PF	1-900003-014	Electromotive	Type DM15	3
	A18	Capacitor 33 PF	1-900003-017	Electromotive	Type DM15	1
	A19	Capacitor 43 PF	1-900003-020	Electromotive	Type DM15	1
	A20,A21	Capacitor 56 PF	1-900003-024	Electromotive	Type DM15	2
C36	A12-A21	Capacitor 1.7-11 PF	1-900065-001	E.F.Johnson	187-106-5	10
C37	A12-A20	Capacitor 1000 PF	1-900003-056	Electromotive	Type DM15	9
C38	A12-A21	Capacitor .02	1-900001-005	Amperex	Type C280AE	10
C39	A12-A21	Capacitor .01	1-900001-001	Amperex	Type C280AE	10
C40	A16-A20	Capacitor 470 PF	1-900003-047	Electromotive	Type DM15	5
C41	A12-A18	Capacitor 470 PF	1-900003-047	Electromotive	Type DM15	7
C42	A12	Capacitor 10 PF	1-900003-008	Electromotive	Type DM15	1
	A13	Capacitor 15 PF	1-900003-010	Electromotive	Type DM15	1
	A14	Capacitor 18 PF	1-900003-011	Electromotive	Type DM15	1
	A15-A17	Capacitor 24 PF	1-900003-014	Electromotive	Type DM15	3
	A18	Capacitor 33 PF	1-900003-017	Electromotive	Type DM15	1
	A19	Capacitor 43 PF	1-900003-020	Electromotive	Type DM15	1
	A20	Capacitor 56 PF	1-900003-056	Electromotive	Type DM15	1
C43	A12-A20	Capacitor 1.7-11 PF	1-900065-001	E.F.Johnson	187-106-5	9
C44	A12-A21	Capacitor 1000 PF	1-900003-056	Electromotive	Type DM15	10
C45	A12-A20	Capacitor 1000 PF	1-900003-056	Electromotive	Type DM15	9
C46	A12-A21	Capacitor 24 PF	1-900003-014	Electromotive	Type DM15	10

REF DESIG		DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
	On Boards					
C49	A12-A21	Capacitor .01	1-900001-013	Amperex	Type C280AE	10
CR1, CR2	A12-A21	Diode 1N4148	1-913007-001		1N4148	20
L1	A12-A21	Coil	1-906006-003	Precision Coil	LR23	10
L2	A12-A21	Choke 10 UH	1-906002-015	JW Miller	70F105A1	10
L3-L5	A12-A21	Coil	1-906006-008	Precision Coil	?	30
L6	A12-A15	Coil 1/4 ID, 2½T	1-402965-001	Gertsch	1-402965-001	4
	A16-A20	Coil 1/4 ID, 3½T	1-402965-003	Gertsch	1-402965-003	5
	A21	Coil 1/4 ID, 4½T	1-402965-002	Gertsch	1-402965-002	1
L7	A12-A15	Coil 1/4 ID, 2½T	1-402965-001	Gertsch	1-402965-001	4
	A16-A20	Coil 1/4 ID, 3½T	1-402965-003	Gertsch	1-402965-003	5
	A21	Coil 1/4 ID, 4½T	1-402965-002	Gertsch	1-402965-002	1
L8	A12-A15	Coil 1/4 ID, 2½T	1-402965-001	Gertsch	1-402965-001	4
	A16-A20	Coil 1/4 ID, 3½T	1-402965-003	Gertsch	1-402965-003	5
Q1,2	A12-A21	Transistor 2N3904	1-958000-001	Motorola	2N3904	20
Q3	A12-A21	Transistor 2N3906	1-958000-002	Motorola	2N3906	10
Q4	A12-A21	Transistor 2N5179	1-958018-001	RCA	2N5179	10
Q5	A12-A21	Transistor 2N3906	1-958000-002	Motorola	2N3906	10
Q6,Q7	A12-A21	Transistor 2N5179	1-958018-001	RCA	2N5179	20
Q8	A12-A21	Transistor 2N3904	1-958000-001	Motorola	2N3904	10
Q9,Q10	A12-A21	Transistor 2N5179	1-958018-001	RCA	2N5179	20
Q11	A12-A20	Transistor 2N5179	1-958018-001	RCA	2N5179	9
R1	A12-A21	Resistor 1 K	1-945000-037	Allen-Bradley	Type CB HA-01121	10
R2	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10

REF DESIG		DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
	On Boards					
R3	A12-A21	Resistor 1 K	1-945000-037	Allen-Bradley	Type CB HA-01121	10
R4	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10
R5	A12-A21	Resistor 10 K	1-945000-049	Allen-Bradley	Type CB HA-01121	10
R6	A12-A21	Resistor 150	1-945000-027	Allen-Bradley	Type CB HA-01121	10
R7	A12-A21	Resistor 56 K	1-945000-058	Allen-Bradley	Type CB HA-01121	10
R8	A12-A21	Resistor 1.5 K	1-945000-039	Allen-Bradley	Type CB HA-01121	10
R9	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10
R10	A12-A21	Resistor 10 K	1-945000-049	Allen-Bradley	Type CB HA-01121	10
R11	A12-A21	Resistor 47 K	1-945000-057	Allen-Bradley	Type CB HA-01121	10
R12	A12-A21	Resistor 470	1-945000-033	Allen-Bradley	Type CB HA-01121	10
R13	A12-A21	Resistor 150 K	1-945000-063	Allen-Bradley	Type CB HA-01121	10
R14, R15	A12-A21	Resistor 220	1-945000-029	Allen-Bradley	Type CB HA-01121	20
R16	A12-A21	Resistor 150	1-945000-027	Allen-Bradley	Type CB HA-01121	10
R17	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10
R18	A12-A21	Resistor 1.5 K	1-945000-039	Allen-Bradley	Type CB HA-01121	10
R19	A12-A21	Resistor 1.2 K	1-945000-038	Allen-Bradley	Type CB HA-01121	10
R20	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10

REF DESIG		DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
	On Boards					
R21	A12-A21	Resistor 15 K	1-945000-051	Allen-Bradley	Type CB HA-01121	10
R22,23	A12-A21	Resistor 1 K	1-945000-037	Allen-Bradley	Type CB HA-01121	20
R24,25	A12-A21	Resistor 15 K	1-945000-051	Allen-Bradley	Type CB HA-01121	20
R26	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10
R27	A12-A21	Resistor 3.9 K	1-945000-044	Allen-Bradley	Type CB HA-01121	10
R28	A12-A21	Resistor 47	1-945000-021	Allen-Bradley	Type CB HA-01121	10
R29	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10
R30	A12-20	Resistor 47	1-945000-021	Allen-Bradley	Type CB HA-01121	9
	A21	Resistor 10	1-945000-013	Allen-Bradley	Type CB HA-01121	1
R31	A12-A21	Resistor 3.9 K	1-945000-044	Allen-Bradley	Type CB HA-01121	10
R32	A12-A21	Resistor 220	1-945000-029	Allen-Bradley	Type CB HA-01121	10
R33	A12-A21	Resistor 15	1-945000-015	Allen-Bradley	Type CB HA-01121	10
R34	A12-A21	Resistor 10 K	1-945000-049	Allen-Bradley	Type CB HA-01121	10
R35,36	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	20
R37	A12-A21	Resistor 3.9 K	1-945000-044	Allen-Bradley	Type CB HA-01121	10
R38	A12,20,21	Resistor 560 S.A.T.	1-945000-034	Allen-Bradley	Type CB HA-01121	3
	A13-A19	Resistor 680 S.A.T.	1-945000-035	Allen-Bradley	Type CB HA-01121	7

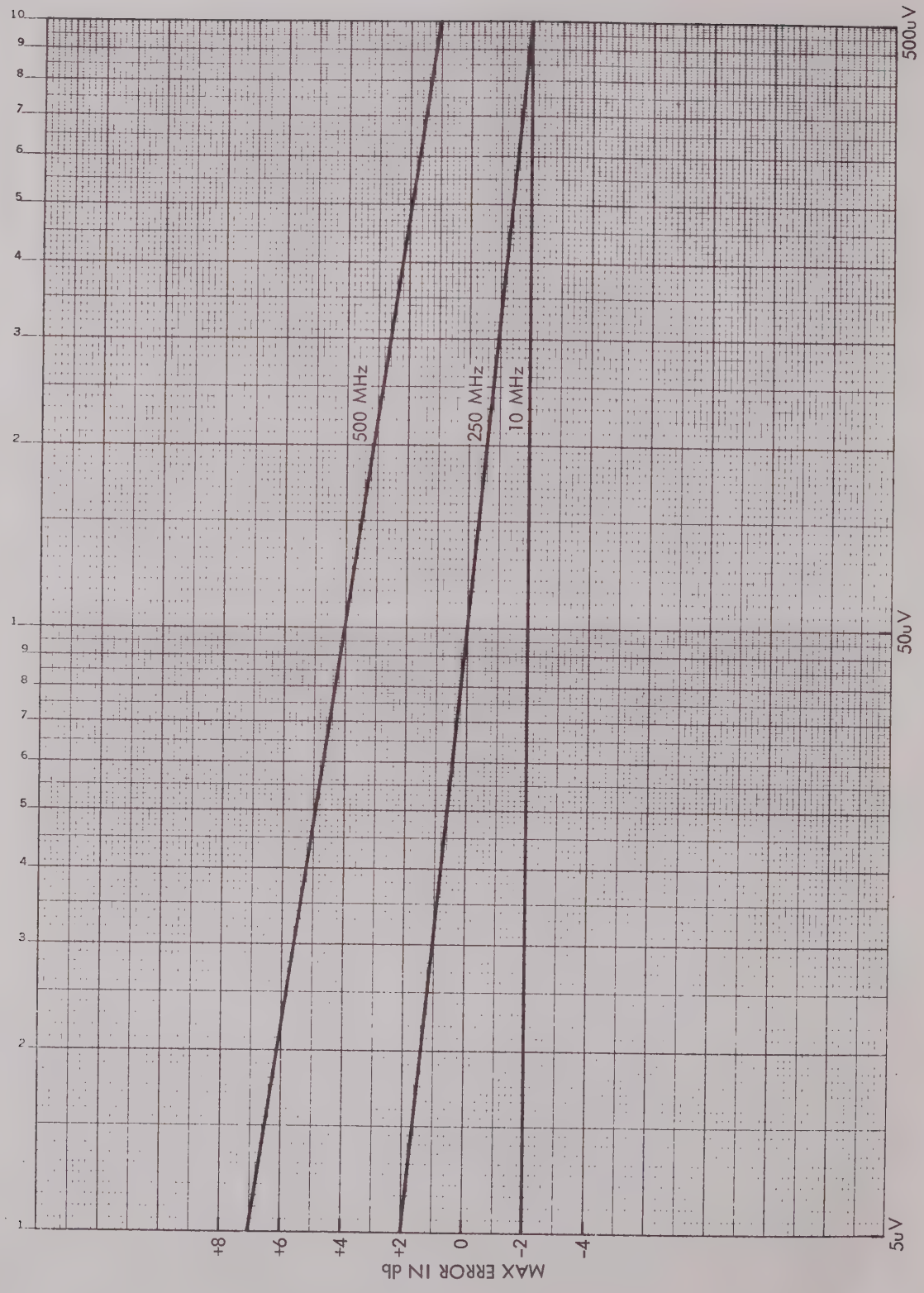
REF DESIG		DESCRIPTION	SINGER PART NO.	MFR	MFR'S PART NO.	QTY
	On Boards					
R39,40	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	20
R41	A12-A20	Resistor 180	1-945000-028	Allen-Bradley	Type CB HA-01121	9
R42	A12-A20	Resistor 3.9 K	1-945000-044	Allen-Bradley	Type CB HA-01121	9
R43, R44	A12-A20	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	18
R45	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10
R46,47	A12-A21	Resistor 1.2 K	1-945000-038	Allen-Bradley	Type CB HA-01121	20
R48	A12-A21	Resistor 100	1-945000-025	Allen-Bradley	Type CB HA-01121	10
R49	A12-A21	Resistor 1.2 K	1-945000-038	Allen-Bradley	Type CB HA-01121	10
R50	A12-A20	Resistor 1.2 K	1-945000-038	Allen-Bradley	Type CB HA-01121	9
U1	A12-A21	I.C. LU380A	1-926018-001	Signetics Corp	LU380A	10
Y1,Y2	A12	Xtl Freq 4.5 MHZ	1-912001-010	Singer	1-912001-010	2
	A13	Xtl Freq 4.4 MHZ	1-912001-009	Singer	1-912001-009	2
	A14	Xtl Freq 4.3 MHZ	1-912001-008	Singer	1-912001-008	2
	A15	Xtl Freq 4.2 MHZ	1-912001-007	Singer	1-912001-007	2
	A16	Xtl Freq 4.1 MHZ	1-912001-006	Singer	1-912001-006	2
	A17	Xtl Freq 4.0 MHZ	1-912001-005	Singer	1-912001-005	2
	A18	Xtl Freq 3.9 MHZ	1-912001-004	Singer	1-912001-004	2
	A19	Xtl Freq 3.8 MHZ	1-912001-003	Singer	1-912001-003	2
	A20	Xtl Freq 3.7 MHZ	1-912001-002	Singer	1-912001-002	2
	Z21	Xtl Freq 3.6 MHZ	1-912001-001	Singer	1-912001-001	2

APPENDIX A: RF OUTPUT ACCURACY

Figure 1 of Appendix A shows the maximum output level error versus output level setting and frequency. Note that the error shown is maximum and the typical error will generally be smaller.

Example: Frequency = 250 MHz
Output Level Setting = 5 μv
Maximum Error = Approx +2 db
Actual Output Level = 5 μv + 2 db (20%)
= 5 μv + 1 μv = 6 μv

The error above does not include the error introduced by the external pads (RFA-20). The error introduced by these attenuators are typically less than 0.5 db each.



Appendix A, Figure 1. Output Level Setting (Log Scale)

APPENDIX B: SET-UP FOR IMPROVED ACCURACY AT LOW LEVELS

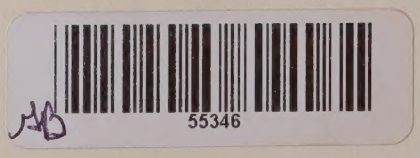
Improved accuracy can be obtained at low levels (.05–.5 μv) by using three external 20 db pads (Model RFA-20).

Accuracy is higher in the .05–.5 μv range with the pads because the RF output control is used over its most accurate range (50 μv to 500 μv).

Example: What is the output level accuracy at 0.5 μv using three RFA-20 pads?

To obtain a final output of 0.5 μv, the RF output control must be set to 500 μv where the error range is -2 db to +1 db (10 MHz to 500 MHz).

Adding the combined maximum error of the pads (±1.5 db), the total error range becomes -3.5 db to +2.5 db.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